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JOURNAL OF THE SOCIETY OF CHEMICAL INDUSTRY

(VOL. XLI)

REVIEW
VOL. V, 1922

373727
12-12-39

LONDON
THE SOCIETY OF CHEMICAL INDUSTRY
CENTRAL HOUSE, FINSBURY SQUARE, E.C.2

Journal of the Society of Chemical Industry

Vol. XLI. 1922

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JOURNAL OF THE SOCIETY OF CHEMICAL INDUSTRY

Vol. XLI. No. 1

January 16, 1922

REVIEW

THE REPORT OF THE COMMITTEE ON SMOKE AND NOXIOUS VAPOURS ABATEMENT.

J. B. COHEN.

The final report of the above committee, of which Lord Newton was chairman, has just been issued (H.M. Stationery Office, 6d.). After passing in review the various committees which have been appointed from time to time to consider the question, and the movements which have been started with the object of suppressing the nuisance from smoke, the report proceeds with a statement of the present law in England and Wales and in Scotland, and of the special powers which have been conferred on certain local authorities.

It is perhaps unnecessary to recapitulate in detail the waste and damage caused by coal smoke as these are carefully set forth in the report, but it may be of interest to quote the figures of the loss in fuel alone.

It has been estimated that approximately 2.5 million tons of potential fuel in the form of soot escapes annually into the atmosphere from domestic fire-places and 500,000 tons from industrial chimneys, i.e., at £2 per ton, an annual loss of £6,000,000. But the damage is not confined to waste of fuel. A careful inquiry in Manchester has shown that the increased cost of household washing due to smoke is over £290,000 a year. To the total cost is further to be added the damage to health, vegetation, agriculture, and building materials. Each of these points has been carefully discussed with expert witnesses.

The report has been issued in two sections. An interim report, having reference to domestic smoke, was issued about a year ago at the special request of the Minister of Health in view of the activity in house construction under the new building scheme.

In the course of that inquiry it was pointed out that domestic smoke is not only larger in amount than industrial smoke but, on account of its acid character and the tarry matter with which it is impregnated, its effects are much more damaging. The tar adheres to everything with which it comes in contact—stonework, brickwork, vegetation and fabrics alike, and the acid then begins its slow but sure process of corrosion.

Evidence was given by Sir Frank Baines, Director of Works of H.M. Office of Works, of the serious disintegration of the stonework of many public buildings (Westminster Abbey, the Houses of Parliament, Buckingham Palace, etc.), photographs of which are included in the report. It was explained that calcium carbonate, which acts as a binding material for the silica grains in certain kinds of building stone, is gradually converted by the action of the sulphuric acid of the soot into calcium sulphate, which is removed by weathering, and the stone then crumbles away.

Among the smokeless heating agents available for domestic use which came under discussion were anthracite, gas-coke, low-temperature or semi-coke,

mineral oil, gas and electricity. In each case expert evidence was called, including that of heat engineers, gas and electrical engineers, architects, sanitary inspectors, and medical officers.

The following is a summary of the general conclusions of the committee. It was satisfied that means which produce little or no smoke are available and practicable for cooking, heating water, and warming rooms. The old-fashioned open kitchen-range with back-boiler was universally condemned as inefficient, wasteful of fuel and labour, and productive of smoke.* The committee considers that wherever a supply of gas is available a gas-cooker should be installed in lieu of a coal-range; that the cheapest and most efficient method of providing a supply of hot water, where a central supply is not practicable, is by a coke-fired boiler; that a central hot-water supply for detached houses, where practicable, is a desirable system if it can be provided at a moderate cost, and for tenement houses a central supply is practicable and should be universally installed; that the system of supplying coke-fired boilers for hot water and radiators should be more generally employed. In this connexion the report states that members of the committee visited the Austin Motor Company's village at Northfield, near Birmingham, where each bungalow and house has its own central heating served by a coke-stove which carries hot water to the radiators and by means of a calorifier also furnishes the domestic supply. The dwellings are smokeless, popular with the tenants, economical of fuel, and well-ventilated. By the installation of this central-heating plant and the provision of a gas-cooker in each house, the estimated saving in the initial structural cost of each bungalow was £30, owing to the economy effected by the elimination of fire-places, chimney-stacks, etc. The report continues that as far as practicable gas-fires or hot-water radiators with adequate means for proper ventilation should entirely supersede the old-fashioned open coal-fire. It was pointed out by Mr. Murray, architect, and Mr. Goodenough, gas engineer, that flues for gas-fires could be adapted to the thickness of an ordinary wall and so dispense with chimney breasts and stacks with a notable saving in building costs. The final conclusion of the report is in the form of a concession to the prejudice, which is still very general, in favour of the open fire, and the committee therefore limits its recommendation to this extent, namely, that in none of the houses built with the assistance of the Government subsidy should more than one, or, in exceptional circumstances, two, coal-grates be installed.

The subject of industrial smoke which is embodied in the final report is divided under two headings—the smoke from boiler furnaces and the smoke from other manufacturing processes.

* In a recent report of the Fuel Research Board (cf. this Issue p. 13 R), which embodies Mr. Fishenden's experiments on the relative efficiency of low-temperature coke and coal, it is stated that a coke-fired boiler for heating water attached to and forming part of the range, shows an efficiency of 41 to 45 per cent. of the calorific value of the coke, as compared with a maximum of 15 per cent. in the case of the old back-boiler of the open range using coal.

In connexion with this inquiry the committee visited various industrial centres, namely, Manchester, Glasgow, Stoke-on-Trent, Sheffield, and Swansea, and took evidence of manufacturers as well as of their victims. Moreover, two members of the committee—the chairman and Mr. E. D. Simon—visited some of the industrial centres of Germany, and a copy of their report is appended.

In the recommendations concerning industrial smoke the committee does not propose any new legislation, but to modify the existing law in the following respects:—That the Minister of Health should be given clearly-defined power to compel or act in place of any defaulting authority which refuses to perform its duty in administering the law with regard to smoke; that the general legal obligation on all manufacturers, users, and occupiers of any business premises or processes, engines or plant of any description whatever, should be to use the best practicable means, having regard to all the circumstances of the case, for avoiding the pollution of the air by smoke, grit, or any other noxious emission (questions of cost being taken into account in determining what is practicable). That the Minister of Health should be empowered to fix standards from time to time, and in any case in which the emission exceeds the standard so fixed the onus of proof that the manufacturer is using the best practicable means should lie with the manufacturer; that the duty of enforcing the law with regard to the pollution of the air by smoke should be transferred from the local sanitary authorities, in whose jurisdiction it now rests, to the county authorities, i.e., the councils of counties and county boroughs; minor authorities should still have power to take proceedings if they so desire; that the Minister of Health should be empowered to constitute joint committees consisting of two or more councils in cases where it appears to him that this course would lead to the better administration of the law with regard to smoke in a given area; that the Minister of Health should assign to one or more competent officers the duty of advising and assisting local authorities and manufacturers concerning difficult smoke problems; these officers should report annually on the steps which are being taken and the progress which has been made in the suppression of avoidable smoke; that the law should enable much larger fines to be imposed than at present; and, finally, that the existing statutory provisions should be consolidated in one measure.

In regard to noxious vapours it is recommended that the Alkali, etc. Works Regulation Act, 1906, should be amended so as to apply generally to all manufactures from which noxious vapours might come; that a list of such noxious vapours should be included in the Act and that the Minister of Health should be empowered to add to the list from time to time other noxious vapours after due inquiry; that a general obligation be placed on every manufacturer to use the best practicable means for preventing the escape of noxious or offensive vapours; that the present system of registration should be continued and the Minister of Health should be empowered to require the registration of classes of works not at present required to be registered; that the Minister of Health should be empowered to fix standards from time to time after due public inquiry, and that these standards should have the same legal force as those relating to smoke.

In the last page of the report the committee reviews the causes which have led to the present condition of atmospheric pollution and its statements may be briefly summarised as follows—It is mainly due to the indiscriminate and wasteful use of raw coal for all purposes, industrial and domestic, to widespread indifference or resignation to a condition of things which people believe to be unavoidable, or to a common delusion that smoke spells prosperity.

This attitude of indifference is reflected in the apathy of the great majority of local authorities throughout the country which have failed to do their duty. The committee regards the inaction of the central authority as the chief factor in the failure to deal with the smoke evil, and says that no Government has taken any action for many years except to appoint committees whose labours have led to little or no result.

It is to be hoped that the Minister of Health will act upon the present report, and that it will not be consigned to that silent bourne to which the reports of so many departmental committees find their way.

INDUSTRIAL FATIGUE IN CHEMICAL WORKS.

E. F. ARMSTRONG.

Scientific control in a works must include the study of the human factor, particularly the health and the safety of the worker. Carelessness on the part of the worker, which may often arise from fatigue, is the cause of most accidents, and the occurrence of an undue proportion in any section of the works should always be investigated from this point of view. Similarly health, apart from the incidence of epidemics or unfavourable climatic periods, also has some connexion with fatigue. Labour statistics should be kept in every works, and, if intelligently studied, afford much information concerning the conditions unfavourable to efficiency. The most useful statistics comprise: the number of employees classified according to sex and age (adults and juveniles under 18), and for each of these classes the number of hours per head per week—or month—of time lost due to (a) bad time-keeping, (b) sickness, (c) slackness of work; the hours per head of overtime worked; the number of accidents, recorded as severe or slight; the labour turnover, i.e., the number started each month expressed as a percentage of the number employed. Such figures are, of course, compiled departmentally, but it is sufficient to review them as a whole.

The term "Industrial Fatigue" has of late years been used in a special and restricted sense to connote some of the effects of repetition work in which certain operations involving a minimum number of muscular movements are repeated with maximum rapidity, such as occur especially under piece-work conditions. During the war there was a good deal of work in the performance of which the human being became very nearly the equivalent of a machine, and it was possible to study the effect on output of meal times, rest periods, shorter daily hours and other factors. Some attempt was then made to study these problems on scientific lines, at first by the Health of Munition Workers' Committee, and subsequently by the Industrial Fatigue Research Board, appointed in July, 1918. In the main the investigations have been confined to industries in which piecework is the rule and processes are regulated by machines. In the chemical industry repetition work is less common and the shift workers who manipulate the continuous processes must needs be men with a certain amount of intelligence, far removed from mere machines; even in the best-conducted processes variations due to raw materials, steam pressure, and a variety of known and unknown causes, are always likely to occur. In such cases common sense and experience are brought into action, and the knowledge of the foreman or "old hand" proves valuable.

In the ideal factory most of the process-men would be of superior education with a sufficient knowledge of the process and of chemistry and

physics to ensure yields and technical figures beyond our present attainment, though it must be confessed that the present younger generation makes up in carelessness and indifference for any superiority in learning it may possess over its fathers.

Much of the chemical process-work is classed as light work, though certain operations, such as furnace work, involve heavy physical effort. The current practice is to divide the day into three shifts of eight hours, the shifts being relieved at 6 a.m., 2 p.m., and 10 p.m. The shifts change about at the week-ends, two of them usually working an extra half-shift, whilst the third shift has the week-end off. The former practice of running twelve-hour shifts with a full twenty-four hours' work at the week-end passed away finally at the instance of the Chemical Trade Joint Industrial Council, and, it is hoped, will never return.

Experience has shown that change in the shift does much to break down any monotony in the work; the men profit to the full from the daylight periods when they are off work, and most of them keep allotments or have other outdoor hobbies. In works where careful statistics of sickness are kept, there is no evidence that the shift men are better or worse in health than the day men. The week's holiday with pay which has long been a custom in the chemical industry—generally coupled with some condition as to good time-keeping—is also a factor in promoting the health of the employees.

Industrial fatigue is also reduced by another factor, namely, that in the course of a period of years in an old-established works most of the jobs on a chemical plant become filled by men who are temperamentally fitted for the particular work, the less suitable either throwing up the work themselves or being weeded out by the management. The vagaries of the plant provide as much or as little excitement in the daily routine as the worker prefers, so that the feeling of monotony—due so often to uncongenial employment—does not arise. Moreover, it is only under very abnormal conditions, such as prevailed during the latter stages of the war, that the plants are run at such intensity as to cause actual overstrain of the workers.

The avoidance of the effects of industrial fatigue in such cases where repetition work does occur, as, for example, in packing into small tins, is not very difficult if ordinary common sense, plus a little science, be used. Long hours or prolonged periods without a rest are to be avoided, and good lighting and ventilation are especially necessary when chemicals are handled. The time at which juveniles start work should not be so early as to prevent them from obtaining a proper breakfast. The rest periods of a few minutes, so frequently advocated, are of doubtful utility, as the worker will take them of his or her own accord if the need be felt. When a process involves more than one operation worked by a team, a change-round should be made periodically.

Work requiring greater care, i.e., more use of the intelligence, cannot be done as piecework, but must be paid for as daywork, a reasonable standard of quality and output being required. In a well-managed works with a large number of employees, workers will be specially selected for this purpose, and they will be found usually to represent a slightly better class socially, and to have had a better education than the mass of the workers. Under these conditions carelessness, the outward expression of industrial fatigue, will occur but rarely. As a general rule, repetition work of all kinds is better performed by girls than by boys; the whole nature and outlook of the latter is essentially foreign to such work, which for them is largely to be regarded as a blind-alley occupation, once the lesson of discipline and co-ordinated movement to be learnt from it has been acquired.

It is perhaps desirable to emphasise that to-day, owing to the short hours of employment and the general disinclination of the worker to exert himself, genuine industrial fatigue is very rare. A noticeable effect of the reduced hours in industry has been the tendency to undertake a second job and to misuse the increased leisure period; on its introduction individual workers exhibited greater fatigue and kept worse time than before.

The chemical industry, like other industries, has its occupational diseases, but the precautions necessary to minimise the risk of these, and to alleviate their effect, are, generally speaking, well-understood and properly enforced.

THE MANUFACTURE OF TNT DURING THE WAR.*

T. M. LOWRY.

The manufacture of TNT by the Ministry of Munitions affords a fascinating illustration of the evolution of a typical laboratory preparation in organic chemistry into a fully-fledged manufacturing process, yielding in its final stages over 1000 tons per week of the finished product. This evolution hinged very largely on a detailed physico-chemical study of the processes of nitration and purification. Thus, whilst on a small scale trinitration may be carried through in one operation and the finished product separated in a solid form, this method is extremely wasteful as a manufacturing process, since the acid used for nitration must be able to absorb all the water set free in the various stages and yet at the end be strong enough to effect the complete trinitration of the compound. This can only be done by the use of oleum, and it was largely to avoid this that the two-stage process of nitration was worked out. Again, when nitration has been completed, the mere precipitation of the finished product by drastic dilution with water is a crude and wasteful operation which could not be maintained in large-scale manufacture.

The actual process adopted was an ingenious device of nitration in two (or even three) stages, a conspicuous feature being the use of the less nitrated material, both to extract the more highly nitrated products from the waste acids and to utilise in the most effective way the nitric acid which they contained. Thus, in the first stage, toluene, or Borneo petroleum containing toluene, was used to extract the nitric acid and any partially nitrated toluene from waste acids resulting from "mononitration," after diluting to about 25 per cent. of water and cooling to 30° C.; this operation, which gave a product containing about 50 per cent. of MNT (commonly referred to as "1 $\frac{1}{2}$ NT"), was regarded as essentially an extraction rather than a nitration. In the second stage the "1 $\frac{1}{2}$ NT" was nitrated to about "1 $\frac{3}{4}$ NT," at about 50° C., the actual nitration being carried beyond the stage of mononitration in order to relieve the final stage of trinitration from some of the dilution consequent upon the introduction of a second nitro-group. For this nominal "mononitration" of toluene, the waste acid from "trinitration" was used, after diluting somewhat to precipitate the TNT and adding more nitric acid, *e.g.*, by using dilute nitric acid instead of water to effect the precipitation of the TNT. The final trinitration is by far the most difficult operation; the "1 $\frac{3}{4}$ NT" resulting from

* * Technical Records of Explosives Supply, 1915-1918, No. 2. Manufacture of Trinitrotoluene (TNT) and its Intermediate Products. Pp. 116. Ministry of Munitions and Department of Scientific and Industrial Research. (London: H.M. Stationery Office, 1920.) Price 17s. 6d. net.

the nominal "mononitration" was dissolved in 100 per cent. sulphuric acid and nitrated by adding mixed acid below 70° C., keeping for three hours at 70° C., and then heating to 110° C. during one hour and maintaining at this temperature for two hours more. After cooling to 80° C. only, so as to maintain the product as a liquid, the acid would retain in solution up to 30 or 40 per cent. of TNT. To return this to the earlier stages of nitration would be wasteful, and dilution to 15 per cent. of water was found to precipitate most of the TNT, whilst leaving the waste acids strong enough to effect the "mononitration." As already explained, the original detoluation of the waste acids by extraction with toluene became merged in a process of "mononitration" of toluene, which in its turn had already been partially nitrated in the same way at an earlier stage in the process.

The actual process of nitration is essentially an interrupted counter-current system. The ideal process is a real counter-current system in which toluene flows in at one end and escapes as TNT at the other, whilst mixed acid flows in the reverse direction and emerges as waste acid, stripped of all its nitric acid and carrying away with it all the water produced in the successive stages of nitration. It is of interest to know that this continuous process was actually developed, at least to the stage of converting MNT into TNT, and that it gave an almost miraculous production, a plant designed to produce 100 tons giving the amazing output of 500 tons per week. Under such conditions the chief problem to be faced was the supply of materials to satisfy the immense capacity of the plant.

During the mononitration of toluene about 4 per cent. of the hydrocarbon is converted into *m*-nitrotoluene, and on further nitration can only yield the less stable isomers of the symmetrical 2,4,6-trinitrotoluene. These, with imperfectly nitrated material, gave an impure product, the essential constituent of which (a quaternary eutectic of three isomeric forms of TNT with DNT) remained liquid at atmospheric temperatures. This liquid eutectic, when TNT was used alone or mixed with only an equal weight of ammonium nitrate, was liable to ooze through the screw-threads of a shell and was a fertile cause of premature explosions. Purification of the crude TNT was, therefore, an urgent necessity, although it involved a considerable loss of material. It was found that whereas crude TNT was liable to froth when mixed in the molten state with ammonium nitrate containing pyridine or thiocyanate, no frothing took place when the TNT was purified. The purification can be effected by crystallising out dinitrotoluene, but this is undesirable as it disturbs the normal course of nitration. Various methods involving the use of solvents were developed, many of them highly ingenious, *e.g.*, melting the TNT with a little phenol, and removing the impurities with the phenol in the form of a liquid eutectic by centrifuging after slow crystallisation, washing finally with water on the centrifuge to remove the phenol. Washing the coarsely crystalline "tolfee" by grinding with alcohol was actually used on a very large scale in spite of the very serious fire-risk that it involved—a risk which fortunately never developed into a liability. But a final method of purifying was reached by making use of the mobility of one of the nitro-groups in the unsymmetrical TNT's, which could be replaced by a sulphonic group $-SO_3Na$, merely by warming with sodium sulphite, thereby removing the two most important impurities in a form in which they were soluble in water. This process had the great advantage that it carried no fire-risk and could be carried on safely and conveniently as a part of the normal process of nitration, instead of being removed for safety to a distant factory, with all the disadvantages of transport, rehandling and repacking. It also removed practically none of the symmetrical

TNT, not even the amount required to form the eutectic; the DNT was also left, but by giving increased care to the trinitration, this had already been reduced to very small proportions. This process could even be applied to recover some TNT from the residue of the alcohol-purification process, by removing the unsymmetrical isomers, giving a mixture of DNT and TNT which could be worked up again as raw material for the ordinary process of trinitration.

It may be asserted, with little fear of contradiction, that the nitration of an aromatic compound has never before been studied in such detail as in the present publication; it constitutes a record of unique value, if only as showing how much can be done to effect economy and to promote smooth working when industry is able to mobilise all the resources of science to assist in the solution of its problems.

SOCIETY OF CHEMICAL INDUSTRY.

MEETINGS OF COUNCIL.

Meetings of the Council were held on November 11 and December 9, the Hon. Treasurer, Mr. E. V. Evans, presiding. At the former meeting a vote of sympathy was passed to Mrs. John Spiller, on the death of her husband (*cf.* J., 1921, 460 R), and a letter was read from Dr. Ruttan, in which he expressed the hope that he would be in England in May next and be able to visit some of the Local Sections. The Council decided that the chief duty of the General Purposes Committee was to consider matters which arose between two meetings of Council and which required immediate attention. On the subject of co-operation with the Chemical Society (*cf.* J., 1921, 139 R), letters were read from the Local Sections conveying practically unanimous approval of the proposals of the Chemical Society which had been recommended to them by the Council. Messrs. J. L. Baker and F. H. Carr were appointed to serve upon a standing committee on the Standardisation of Scientific Glassware to be set up by the National Physical Laboratory; and Mr. W. F. Reid was nominated to represent the Society upon the General Committee of the British Empire Exhibition, 1923, pending the acceptance of Dr. Ruttan.

At the December meeting the Council approved of the projected institution of a General Council of the Canadian Local Sections to promote and safeguard the interests of the Society in the Dominion and to consider questions that may arise regarding Federal and Provincial legislation. On the report of the Publications Committee, it was agreed that various books and periodicals located at headquarters, which were not required for the use of the Staff, should be offered to the Chemical Society and to those Local Sections which possess a library. It was also resolved that the first Messel Memorial Lecture should be delivered in Glasgow on the occasion of the next Annual Meeting; that the (first) medal to be presented to the lecturer should, if practicable, be made from the platinum of the platinum dish bequeathed to the Society by Dr. Messel; and that Prof. H. E. Armstrong be asked to give the lecture. Prof. Armstrong has since accepted the invitation. The next award of the Society's Medal has been deferred until 1923.

Fifty-six candidates have been elected members of the Society since October last; of this number 35 are resident in the United Kingdom, 7 in the Dominions Overseas, 7 in the United States, and 7 in other countries.

COMMITTEES OF COUNCIL AND REPRESENTATIVES ON OUTSIDE BODIES.

Publications Committee.—Messrs. C. A. Keane (chairman), J. Allan, E. F. Armstrong, J. L. Baker, E. R. Bolton, F. H. Carr, W. H. Coleman, C. F. Cross, J. T. Dunn, C. J. Goodwin, J. W. Hinchley, W. R. Hodgkinson, E. Grant Hooper, L. L. Lloyd, B. D. W. Luff, S. Miall, G. T. Morgan, W. R. Ormandy, J. R. Partington, J. A. Reavell, W. F. Reid, H. D. Richmond, E. Thompson, and W. G. Wagner.

General Purposes Committee.—Messrs. S. Miall (chairman), E. F. Armstrong, J. L. Baker, F. H. Carr, and C. S. Garland.

The President and the Hon. Treasurer are *ex-officio* members of all committees of Council.

The following have been nominated by the Council to represent the Society on outside bodies:

British Empire Exhibition, 1923.—Dr. R. F. Ruttan.

British Association Fuel Economy Committee.—Mr. E. V. Evans.

British Empire Sugar Research Association.—Messrs. A. R. Ling and J. W. Macdonald.

British Engineering Standards Association.—Sectional Committee on Chemical Engineering: Messrs. C. S. Garland, C. J. Goodwin, W. R. Ormandy, and J. A. Reavell. Aircraft Sub-committee on Chemicals: Prof. W. A. Bone. Sub-committee on Textiles: Mr. C. F. Cross. Sub-committee on Dopes: Dr. J. N. Goldsmith.

Committee on Standardisation of Scientific Glassware, National Physical Laboratory.—Messrs. J. L. Baker and F. H. Carr.

Conjoint Board of Scientific Societies.—Dr. A. Holt and Dr. C. A. Keane.

Council of the Exhibition of the Coal Smoke Abatement Society.—Dr. S. Miall.

Federal Council for Pure and Applied Chemistry.—Dr. C. A. Keane, Dr. S. Miall, and Mr. F. H. Carr.

Governing Board of the Imperial College of Science and Technology.—Sir William Pearce.

Imperial Mineral Resources Bureau.—Lead, Silver, Zinc, and Cadmium Committee: Mr. H. M. Ridge. Aluminium, Magnesium, and Sodium Committee: Dr. R. Seligman. Minor Metals Committee: Mr. W. G. Wagner. Chemical Industries Committee: Mr. C. S. Garland. Publications and Libraries Committee: Mr. W. J. A. Butterfield. Abstracts Committee: Prof. H. Louis and Mr. T. F. Burton.

Institute of Chemistry Standards Committee.—Dr. A. Holt, Prof. A. R. Ling, and Mr. W. G. Wagner.

National Physical Laboratory (General Board).—Sir William Pope and Prof. F. G. Donnan.

JOINT MEETING WITH THE INSTITUTION OF MECHANICAL ENGINEERS.

The joint meeting of the Society and the Institution of Mechanical Engineers which was held in the rooms of the latter at Storey's Gate, S.W., on January 6, was the second meeting of its kind, the first having been held in March of last year, when M. Paul Kestner read his paper on the purification of boiler feed-water. On the present occasion Mr. G. M. Gill, chief engineer to the South Metropolitan Gas Co., read a paper on "The Co-operation of the Engineer and Chemist in the Control of Plants and Processes." Capt. Riall Sankey, president of the Institution, was in the chair, and he was supported by Mr. J. Arthur Reavell, Dr. S. Miall and others. The following is an abstract of Mr. Gill's paper:—

A great need exists to-day for the standardisation of materials used for manufacturing purposes. The South Metropolitan Gas Co., being a user of coal to

the extent of 1·25 million tons per annum, has established a coal-testing laboratory at Newcastle-on-Tyne. Excellent results are anticipated from better-informed buying and in the working of plant to suit each consignment of coal. The results of tests of four typical coals are summarised and show a wide variation in quality and in efficiency of cleaning. The author suggests that each colliery should grade coals from the various pits within the narrowest practical limit of quality; in the working of collieries there is fine scope for mutual co-operation between engineer and chemist, and the increased advantage to consumers would react favourably upon the whole coal industry.

There is also a lack of uniformity, which gives rise to difficult problems, in the size and quality of firebricks, retorts, and other refractories. Firebricks supplied by two well-known manufacturers varied considerably in length, width, and thickness. Such defects in manufacture arise through the absence of scientific control, and the author suggests that methods be instituted for the continuous sampling and analysis of mixtures in use, for the use of heat-recorders in kilns, for definite limiting standards of size and shape, and for guaranteed working to specification. It is suggested that the extra cost of applying such materials would be covered by the sale of materials made, since the control proposed would result in a more consistent quality of brick, with consequent increased sales. It would result also in a reduction in the number of rejected bricks, save fuel costs in kilns, increase capacity of plant, and effect improvements which would result from increased knowledge of the process.

The South Metropolitan Gas Co. has applied scientific control both to the working of manufacturing plant and to the maintenance of the quality of gas supplied. A suitable system of chemical control for the average retort house can be provided at a cost of £3 8s. per diem, or 0·5 per cent. of the total expenditure, and this cost should be recouped many times over.

The results of tests at one of the company's works, over a period of seven days, on the percentage of carbon monoxide in producer gas, the quality of waste gases leaving the retort settings, and temperature measurements in the combustion chambers show, by the variations, the necessity of such control in order to enable faults to be remedied as soon as disclosed. With a view to maintaining the standard quality of gas, the calorific value of the gas being made is tested at intervals of half an hour both day and night, the result being immediately telephoned to the official in charge.

The author, having had experience in collaboration with a well-constituted chemical department, has no hesitation in recommending manufacturers to obtain similar assistance and thereby improve the stability and prosperity of the business.

NEWS FROM THE SECTIONS.

BRISTOL AND SOUTH WALES.

A discussion on "Catalysis" was held at the meeting in Bristol on December 1, Mr. C. J. Waterfall presiding. Prof. F. Francis opened it and illustrated the general principles of catalytic action by numerous experiments. Mr. A. Marsden described the Carpenter-Evans process for removing sulphur compounds from coal gas with nickel catalyst and gave the cost of treatment at about 0·75d. per 1000 cb. ft. Prof. J. W. McBain described Langmuir's theory of unsaturated valencies and discussed its application to catalysis. He also described a new silica gel, patented in the United States, which will probably find many important industrial applications. The substance, which is chemically inert and non-toxic, has extraordinary avidity for moisture

and can therefore be used as a drying agent; it is also applicable in the recovery of various vapours, such as that of petrol from natural gas.

In presiding at the meeting held in Cardiff on December 2, Mr. C. J. Waterfall announced that the formation of a separate Section for South Wales was under consideration and that local members would shortly be invited to a special meeting to discuss the question. Prof. C. M. Thompson, vice-chairman, expressed the hope that a vigorous Section would be formed and meetings held in Cardiff and Swansea.

Mr. G. Rudd Thompson then gave an address on "The Experiences of a Public Analyst" which covered a wide field and included some illustrations to show that valuable assistance can, at times, be given to the law by the application of scientific method. Reference was made to some of the more notable local crimes of recent years in which the services of the public analyst were of undoubted assistance to the police in bringing the criminals to justice. The lecturer also referred to some of his experiences as a witness in court, which went to show that it was not always the cross-examining counsel who "got the best end of the stick," although he admitted that on one or two occasions he had been most skilfully trapped by well-placed questions put by lawyers. Mention was also made of some early experiences of pioneer work which contributed to the fixing of limits for boric acid and other preservatives in food.

EDINBURGH AND EAST OF SCOTLAND.

At the meeting held on December 13, Dr. H. E. Watt in the chair, a discussion on "Methods of Drying" was opened with short papers by Mr. H. R. Baxter and Mr. W. G. Martin.

Mr. Baxter discussed the general principles involved in drying processes and described the various mechanical, physical, and chemical devices used for removing water. A detailed description was given of the system of "tunnel drying," in which the material to be dried is placed on trucks which are propelled against a current of dry air forced through the tunnel either by pressure or by suction. For this method the "Plenum" or pressure system of inducing an air current was stated to have considerable advantages over the suction system.

Mr. Martin treated very thoroughly some of the various factory methods of drying, noting the advantages and difficulties of each system. Centrifugal, vacuum, hot-air-room driers, kilns, drum- and cell-driers were described and illustrated by sectional drawings. Some of the more modern types of driers, which have distinct advantages over their predecessors, were then discussed. The modern prototype of the hot-air-room drier is the American "Hunter" kiln, in which the stream of inflowing air, induced by a stack or chimney, is made to pass over a battery of steam-heated pipes. The heated air is then deflected over a supply of steam-heated water and thence into the kiln proper. Automatic control-valves regulate the temperature of the kiln, and the temperature and level of the water-bath, and when these are once set for the particular requirements as to relative humidity and temperature, the control becomes automatic and drying proceeds very rapidly.

The modern form of the direct-fire kiln for stable, innocuous materials is the Simon's drier, which contains revolving steam-heated tubes. The material to be dried is fed into the machine at one end and diverted to the other by means of flanges which are driven in a rotary direction. A certain material with a moisture content of 5 per cent. was fed into this machine when running at 48 r.p.m. with 80 lb. steam-pressure per sq. in. in the tubes;

samples taken at the exit and quickly bottled during a two hours' run and at half-hourly intervals had a moisture content of 0.02 per cent., 0.02 per cent., 0.02 per cent., 0.03 per cent. respectively.

The possibility of using flue gases as a source of heat for drying was also considered.

GLASGOW.

The annual dinner was held on December 13, in Ferguson and Forresters' Restaurant, Glasgow, when the chairman of the Section, Mr. J. H. Young, presided over a representative gathering of members accompanied by lady friends. The first toast—"H.M. the King"—was proposed by the chairman, and subsequent toasts were given at intervals during an excellent musical programme.

Prof. R. M. Caven, in proposing "The Society," reviewed the aims and scopes of the three great chemical societies of this country, viz., the Chemical Society, the Society of Chemical Industry, and the Institute of Chemistry. He specially referred to the purpose for which the Society of Chemical Industry had been formed some forty years ago by Sir Henry Roscoe and others—namely, "the dissemination of chemical principles throughout industry." In fulfilling this great purpose the Society had shown what fellowship really was, and it was this fellowship that formed the golden thread which, stretching from London, throughout the mother country, to Canada, New York, and Australia—had bound the many Sections together in one body. In reply, the chairman expressed the hope that the Society—and especially the Section—was entering upon a period of increased usefulness and prosperity, and remarked that the recently increased activity among members of the Section augured well for the coming annual meeting in Glasgow.

During the proceedings the chairman presented a silver tea-service to Dr. G. S. Cruikshanks, the late local secretary, as a token of esteem and gratitude of the members for the work he had done during his eight years of office.

The toast of "The Ladies" was given by Mr. R. F. Stewart and replied to by Mrs. J. A. Cranston. Mr. S. B. Langlands expressed the thanks of the meeting to all the artistes, and Prof. G. G. Henderson gave the toast of the chairman.

MONTREAL.

The third general meeting of the Section was held on December 16 in the Physics Building of McGill University, the chairman, Mr. H. W. Matheson, presiding. Two hundred and sixty members and friends were present, including Dr. R. F. Rutten, the President of the Society. The lecture on "Wireless Telephony," by Dr. Evc, aroused such interest that every seat and all standing-room were occupied some time before the appointed hour, and many people were unable to gain admittance. Dr. Evc traced the evolution of wireless telephony from its experimental stage to the present day, and illustrated the principles involved by lantern slides and experiments. Following the lecture a demonstration was given by the Marconi Company, under the supervision of Mr. A. H. Morse. A long-range concert was heard with wonderful clearness, and the members of the audience were enabled to time their watches on the stroke of ten of the clock at the Arlington Wireless Station, Washington, U.S.A., 600 miles distant.

The present session is proving a record one in many directions, for which the publicity obtained through the Annual Meeting is in part responsible. The dinners that are held before the meetings are very successful in getting members and their friends to know one another. At the beginning of this session a big chemical firm volunteered to invite and

entertain twenty-five senior students from McGill University and Montreal University to one dinner, and this invitation was soon followed by similar offers from five other firms. The invited students are all fourth-year men and take an active part in the discussions, and it is thought that this new feature will undoubtedly result in an extended membership in years to come.

NEWS AND NOTES.

CANADA.

Industrial Notes.—The Weeks Engineering Corporation, a United States organisation, is erecting a plant at Welland, Ont., mainly for the production of boiler plates and tubes.

Welsh tinplate-makers have secured an order for 150,000 boxes of tinplate from the British Columbia Packers Association. For years makers in the United States have controlled this market.

The Grand Trunk Railway Company has just placed an order for 15,000 t. of steel rails with the Dominion Iron and Steel Co., and for 14,000 t. with the Algoma Steel Corporation.

The Bishepprie Manufacturing Company, of Cincinnati, Ohio, is erecting a sodium-sulphate plant at Stink Lake, Saskatchewan. The estimated cost of the plant is \$100,000, and it is planned to produce 50 t. of sodium sulphate daily.

The E. B. Eddy Co., Ltd., of Hull, Quebec, which manufactures paper pulp and matches, has purchased the plant, stock and rights of the Dominion Match Co., its strongest Canadian competitor. The latter company has a factory at Deseronto, with head office in Toronto.

The coal lands 36 miles north of Terrace, and north of Kitsumkalim Lake, staked out by the late Lord Rhondra before the war, and the leases upon which lapsed after his death, have been re-leased. They consist of eighteen sections with six seams of anthracite varying in thickness from 18 in. to 7 ft.

The International Nickel Co. of Canada (subsidiary of the International Nickel Co. of New Jersey) has closed its Toronto offices, and the principal officials have resigned. This action has been taken in the interest of economy. Business will be transacted from New York. The Port Colborne and Sudbury plants are closed. The following is a statement of the operating income of the company for the past few years:—1921, \$4,059,607; 1920, \$6,061,762; 1919, \$11,186,305; 1918, \$15,791,485; 1917, \$16,728,913; 1916, \$14,091,612; 1915, \$7,049,112.

Animal and Vegetable Oil Refining in British Columbia.—Messrs. W. R. Beatty and Co. are erecting a refinery for fish and vegetable oils on Industrial Island, B.C. The firm has rendering-plants at Blaine, Wash, Rendezvous Island, B.C., and is constructing a new plant at Nanaimo; and the crude oil from these establishments will be sent to the new refinery. Arrangements have been made for large supplies of dog fish and other raw material, and fertilisers will be prepared from the by-products. The vegetable oils will be derived from soya bean and other oriental seeds and beans.

The Asbestos Industry in Quebec.—The Canadian Johns-Manville Co., Ltd., has commenced the construction of a large manufacturing plant at Asbestos, Quebec, part of the machinery for which will be brought from one or other of the company's seven plants located in the Eastern and Middle-Western States. The products will include asbestos textiles, brake-lining, asbestos slates, paper, roofing, pipe-covering, insulating composition, &c. The plant should be in operation before the New Year.

The annual report of the Department of Mines of Quebec for 1920 states that the quantity of asbestos rock mined during the year was 3,123,370 tons, which yielded 170,500 t. of merchantable fibre. Of this 1026 tons was rated as crude No. 1, valued at \$1,513,139. The total value of the asbestos products was \$14,749,048. The output for the current year will be small owing to the state of trade.

Petroleum.—The town of Terrace, British Columbia, has the "oil fever," and the whole country is being staked out. No drilling has been done as yet.

According to the *Wall Street Journal*, the net earnings of the British-American Oil Company of Canada (petroleum-refining) are estimated at \$1,100,000 for this year. This is equal to 20 per cent. on the \$5,500,000 stock upon which the company is paying 8 per cent.

The gas flow at the well of the Imperial Oil Co. in Pouce Coupo district (*cf. J.*, 1921, 452 n) is reported to be 33 million cb. ft. per day. The gas is stated to be very wet and to have a high gasoline content. The well is situated at Rolla, which is 50 miles from the railroad.

It is understood that the Union Oil Co. of California has taken up its option on the B.C. Refining Co.'s plant at Port Moody, and will proceed with the development of plans involving the expenditure of several million dollars. The refinery will produce the usual petroleum products for the Western Canadian market.

The Imperial Oil, Ltd., subsidiary of the Standard Oil Co., has issued 142,628 shares of its unissued capital stock at \$90 per share, which will bring in about \$12,780,000. The stock is offered to existing shareholders on the basis of one share of new stock for every ten shares of stock held on November 19. The money is required for extending plant, constructing ships, prospecting for oil, etc.

The Petroleum Refining Industry in 1918.—According to the report of the Dominion Bureau of Statistics there were ten petroleum refineries operating in Canada during the year 1918; three were located in Ontario, three in Alberta, and one each in Nova Scotia, Quebec, Saskatchewan and British Columbia. The total capital of these plants is given as \$35,745,410 of which \$23,535,257 is represented as value of lands, buildings, equipment, etc. The 2938 wage-earners received \$3,451,642 and 272 salaried employees were paid \$371,676. The cost of fuel was \$3,242,706 divided as follows: oil and gasoline \$1,721,642; coal \$1,425,850; natural gas and petroleum coke \$95,304.

The total quantity of crude oil handled was 262,641,149 gallons, of which 12,258,184 galls. was produced by Canadian wells. The cost of the oil as received at the refineries was \$23,708,658 of which \$918,896 was for Canadian crude. The total cost of materials used was \$24,451,575, which was distributed as follows:—Crude oil \$22,773,092; sulphuric acid 38,224,856 lb. value \$408,482; caustic soda 1,993,251 lb. value \$45,782; litharge 97,319 lb. value \$11,886; other materials not enumerated value \$843,942; and cooperage stock \$369,167.

The total production was valued at \$37,866,907: gasoline and motor oil 50 per cent., illuminating oil 18.8 per cent., fuel, gas oil, and tar 17.5 per cent., lubricating oils, wax and candles about 10 per cent., and the balance of the income was derived from grease, asphalt and petroleum coke. Miscellaneous expenditures were given as \$2,129,825, 43.4 per cent. of which was made up of charges for repairs to buildings and machinery and the balance included taxes, insurance, rents, royalties (\$177,294), travelling and advertising expenses. On the basis of the figures given, the earnings represented approximately 12.5 per cent. on the total capital employed.

SOUTH AFRICA.

Reported Mineral Discoveries.—*Descloizite*.—The South African Geological Survey announces that a deposit of descloizite, a hydrated basic vanadate of lead and zinc, has been discovered near Messina, in the Transvaal, which contains over 22 per cent. of vanadium pentoxide. So far as is known the only other occurrence of the mineral in South Africa, excluding Rhodesia, is at Tsumeb, South-West Africa.

Gem Tourmaline.—An important discovery of this precious stone is reported from the Usakos district, South-West Africa, where the mineral occurs in a zone of pegmatitic granite in crystals ranging up to 2 ft. in length. The tourmaline is of exquisite quality, shows a wide range of colours, and cuts well. The deposit is being systematically opened up by the Kolonial Gesellschaft für Süd-West Afrika, Swakopmund. — (*S. Afr. J. Ind.*, Dec., 1921.)

Submarine Phosphates on the Agulhas Bank.—On several occasions and at various places specimens of phosphatic nodules have been dredged up off the southern coast of South Africa, especially near the Agulhas Bank and off Saldanha Bay. The nodules consist of phosphatic agglomerations around grains of glauconite and are held to have been formed *in situ* from calcium phosphate of animal origin. The phosphate content is very variable, ranging from 1.31 to 23.54 per cent. of P_2O_5 , and although the utilisation of such submarine deposits is problematical, their occurrence is interesting as providing a parallel to the Cambridge "greensand" and similar deposits. — (*S. Afr. J. Ind.*, Nov., Dec., 1921.)

Zinc Recovery from Waste Waters of Gold Mines.—Fine zinc-shavings are used on the Rand gold-mines to precipitate the gold from the cyanide solutions, and the resulting "zinc slimes" contain metallic gold, unattacked zinc, and some insoluble zinc salts. The undissolved zinc is removed by treating the residue after filtration with a solution of sulphuric acid or sodium bisulphate, but the effluent, which contains about 5 per cent. of zinc, is run to waste. Although about 2232 tons of zinc is consumed annually on the Rand for this purpose, no attempt to recover the zinc in the waste liquor has been made until recently, when the Kominsky process was started on a small scale at Gernistown. As the zinc is to be recovered in the form of paint-pigments, it is necessary to remove the iron compounds present. The process consists in reducing the acidity of the solution to a certain point by adding lime, and adding a measured amount of sodium-chromate solution to convert the ferrous into ferric salts. To this oxidised solution is added a considerable excess of zinc hydroxide obtained by precipitating some of the original solution with caustic soda. Part of the zinc hydroxide is dissolved by the free sulphuric acid and the remainder reacts with the ferric and chromium sulphates to produce zinc sulphate and insoluble ferric and chromium hydroxides. After filtration the zinc sulphate solution is used to prepare the carbonate, oxide, or chromate, and the residual sludge can be used and re-used for precipitating the original liquor until the zinc hydroxide contained in it is exhausted. The cost of the process will be determined largely by the cost of transporting the zinc-slimes solution to the works, and the cost of the precipitants, sodium chromate and carbonate. Filter-presses are used but evaporation will not be required, unless it be decided to recover the sodium sulphate. — (*S. Afr. J. Ind.*, Dec., 1921.)

Sweet Potatoes as a Source of Alcohol.—The *Journal of the Department of Agriculture, South Africa* (1921, 2, 229, 340) describes the production and uses of the sweet potato and directs attention to its possible utility as a raw material for the production of fuel alcohol. Compared with the common

potato, the sweet potato is more easily grown and is a better producer of starch, as it contains 72 per cent. water and approximately 25 per cent. starch and sugar, against 75 per cent. water and 16–24 per cent. starch. Analyses of soils and tubers are given, together with yields per acre, cost of production, etc. — (*Bull. Imp. Inst.*, XIX., No. 2, 1921.)

UNITED STATES.

Research in the Oilseed Industry.—A committee representing the Inter-State Cotton Seed Crushers' Association and the American Oil Chemists' Society conferred recently with specialists on oils in the Department of Agriculture concerning the possibility of conducting basic research on oils in the Government laboratories. The scope of the scheme of work drawn up is indicated by four paragraphs in the report, as follows:—

(1) To develop varieties of cotton seed that will yield fibre of the maximum value and seed containing the maximum percentage of oil, and to determine the effects of cultural conditions.

(2) Isolation and identification of all constituents of crude cottonseed oil, with special reference to effect on refining loss and quality.

This will serve as a foundation for the improvement of refining methods so as to effect a larger yield of refined oil from the raw material, and also as the basis for a correct valuation of the crude oil.

(3) Continuance of work on rancidity with special reference to the nature and constitution of the products formed and their physiological effects.

This will serve as the basis for determining why rancid fats are objectionable or harmful. It will also lead to a knowledge of methods for preventing and removing rancidity in oils and fats.

(4) Isolation and identification of the constituents of cottonseed meal, with special reference to feeding values.

This will lead to the investigation of the so-called toxicity of cottonseed meal and to definite information which will clear up any existing uncertainty regarding its use as a feeding stuff for all classes of farm animals. It will also furnish facts bearing upon the use of cottonseed meal for human use.

"Frary" Metal is an alloy of calcium, barium, and lead in which there may be traces of mercury or other metallic elements. It is now being manufactured on a large scale by an electrolytic process. Pig lead of high quality is melted in iron pots and a mixture of calcium and barium chlorides, in proportion to give a low melting-point, is added. The graphite anode can be raised or lowered at the centre of the pot, and the salts are fused by the electric current, the temperature being controlled by raising or lowering the anode. The chlorides are decomposed, and the resulting metals are absorbed by the molten lead. Considerable amounts of calcium and barium carbides are formed and electrolysis has to be continued for nearly 3 days to produce a lead alloy containing 2 per cent. of the alkaline-earth metals. The resulting alloy is particularly useful as a bearing metal.

Potash in 1920.—The importation of large quantities of foreign potash was expected at the beginning of 1920, but as imports did not meet the demand and the prices were not materially lower than those of domestic salts, a large proportion of the 66 plants reporting production was able to remain in operation during most of the year. The home production was 48,077 t. (166,834 t. of crude material averaging 28.8 per cent. K_2O), or nearly 50 per cent. greater than in 1919. Sales amounted to 41,144 t. K_2O , worth \$7,463,026, an average price of \$1.80 per unit, and stocks in hand at the end of the year were equivalent to 8999 t. K_2O . Natural brines furnished 78 per cent. of the output, and the other sources were:—Molasses, distillery waste, kelp, 7.2; Steffens waste water, 7.1; alunite and silica rocks,

4.4 ; cement-mill dust, 2.4 ; wood ashes, 0.5% ; blast-furnace dust, 0.4 . Various projects for extracting potash from alunite are reported (*cf.* J., 1921, 407 u), and the utilisation of silicate rocks as a source of potash continued to receive attention. The Government kelp-plant at Summerland, Calif., produced 2 tons per day of 80 per cent. potassium chloride in June, 1920, but efforts have been mainly concentrated on the production of by-products, principally bleaching powder and iodine, both of which are now marketed ; in future potash will be regarded as a by-product. Exports of potash salts were very small, but imports amounted to 982,262 l. (224,792 t. K_2O), of which 88 per cent. was used as fertiliser. Approximately 50 per cent. of the imported potash was supplied by Germany and 23 per cent. by France.—(*U.S. Geol. Surv., Oct., 1921.*)

Manufacture of Building Material from Bagasse.—According to the *Louisiana Planter and Sugar Manufacturer*, a plant has been erected at Marrero, La., at a cost of \$500,000, for the manufacture of artificial building boards from sugar-cane bagasse. The plant resembles that of a modern paper-mill, the bagasse is "chipped," "cooked," and "washed," and then sent as pulp to the "beaters," where it is worked until the fibres are of the proper length. A special machine converts the finished pulp into a board, up to 12 ft. wide, and this passes for 4 hours through a long drying-system, emerging quite dry and hard. The new material, known as "Celotex," can be worked like timber and, although lighter than wood, is quite solid and homogeneous. Previous attempts to utilise bagasse for paper-making were abandoned, because it was more valuable as a fuel, but it is stated that the promoters of the present enterprise are now buying the bagasse at a price exceeding its fuel value.—(*Ind. Tr. J., Nov. 3, 1921.*)

BRITISH INDIA.

The Metallurgical Industry.—Important developments are taking place in the Indian metallurgical, and especially in the iron and steel, industry. Not only are existing plants to be enlarged, but several new companies are entering the field, so that by 1926 it is anticipated that the capital invested and labour employed will have risen to 444 million rupees and 125,000 men, respectively ; at present there are three operating companies representing a total capital of 100 million rupees and employing 47,500 men. A list of the old and new metallurgical companies, the location of the plants, and the products manufactured is given below:—

Company.	Location.	Products.
Bengal Iron Co. . .	Kulti . .	.. Pig iron.
Cape Copper Co. . .	Rakha Mines . .	.. Copper.
Eastern Iron and Steel Co. .	Chandil . .	.. Pig iron and steel.
Indian Iron and Steel Co. .	Birapore . .	.. Pig iron.
Tata Iron and Steel Co. . .	Tatanagar . .	.. Pig iron and steel.
Indian Zinc Co.	do. . . . .	.. Spelter and sulphuric acid.
Calcutta Monifeth Works .	do. . . . .	.. Jute-mill machinery.
Indian Steel Wire Products	do. . . . .	.. Wire and pressed-metal products.
Trusean Steel Co.	do. . . . .	.. Concrete reinforcing material
Enamelled Ironware, Ltd. .	do. . . . .	.. Enamelled hollowware.
Indian Enfield Cable Co.	do. . . . .	.. Electric cables.
Tin Plate Co. (of India) . .	do. . . . .	.. Tinplate
Agricultural Implements Co.	do. . . . .	.. <i>Kodalis</i> , ploughs, etc.

The erection of three large new plants is in progress (or contemplated), viz., by the Bengal Iron Co., at Kulti on the East Indian Railway, by the Tata Iron and Steel Co., at Tatanagar, and the Cape Copper Co. at Rakha Mines, both of the latter being on the Bengal-Nagpur Railway. When the present extensive programme has been completed it is expected that the Indian iron and steel industry will supply the enormous domestic demand and also be

able to export to the Far East and other adjacent markets.—(*U.S. Com. Rep., Oct. 24, 1921.*)

A new enterprise, the Kirtyanand Iron and Steel Works, Ltd., Rupnarainpur, Bardwan, floated in February, 1921, with a capital of Rs. 150 lakhs, to manufacture high-class steel castings, etc., is making good progress. The factory is built and most of the plant installed, and manufacture will begin shortly.—(*J. Ind. Indust. and Lab., Nov. 1921.*)

Santonin.—Prior to the war Russian Turkestan was practically the sole source of the world's supply of santonin, the vermifuge extracted from the young flower-heads of *Artemisia maritima*. In view of the high price of the drug, which has risen from £2—3 to £50 per kg., samples of the flower-heads were sent from Kashmir to the Forest Research Institute, Dehra Dun, where they were found to contain from 0.5 to 1.0 per cent. of santonin, according to the time of gathering, as compared with 1.8—2 per cent. in the Russian material. Dr. J. L. Simonsen is of the opinion that the *Artemisia maritima* grown in Kashmir contains sufficient santonin to warrant extraction on a large scale, and that ample supplies of raw material are available. As the leaves are bulky it is suggested that the factory should be erected in Kashmir, and the hope is expressed that the matter will be taken up by the Drugs Manufacture Committee.—(*J. Ind. Indust. and Lab., Nov., 1921.*)

AUSTRALIA.

Petroleum Exploration in Papua.—As the results obtained from the joint venture of the British and Australian Governments in exploring for oil in Papua have not been satisfactory, the British Government has withdrawn from the scheme, but the Commonwealth Government will continue the investigations.—(*Min. Mag., Dec., 1921.*)

GENERAL.

Gas Warfare.—At the International Conference at Washington, on January 7, Mr. Root's resolutions against the use of poison gas in warfare were adopted by the United States, Great Britain, France, Italy, and Japan. Mr. Balfour, in supporting the resolutions on behalf of Great Britain, said that nations would still have to take measures to protect themselves against the use of gas by an unscrupulous enemy ; the example of 1915, when the Allied armies came very near to disaster, could not be ignored. It is proposed that all other nations be asked later to subscribe to the resolution.—(*Reuter.*)

Proposed Catalogue of Scientific Periodicals.—Provided adequate support be obtained, the Conjoint Board of Scientific Societies will publish an octavo volume to include the titles and places of issue of all periodicals containing the results of original scientific research which were in existence on January 1, 1900, or issued subsequently. The names of libraries in London, Oxford, Cambridge, Edinburgh, Dublin, and Aberystwith that receive these periodicals will be inserted, and if possible at least one library in the United Kingdom will be indicated for each title ; and alternate pages will be left blank for alterations and additions. The compilation will be started at once by the staff of the British Museum if a sufficient number of libraries, institutions, and individuals subscribe in advance for a copy at the price of £2 2s. net.

New Italian Commission for Chemical Industry.—According to the *Gazzetta Ufficiale*, a permanent commission for chemical industry has been set up under the Ministry of Commerce and Industry. The commission will include Government nominees as well as representatives of the chemical and pharmaceutical industries, and it will be empowered to exact information from manufacturers.

Natural Gas in Italy.—There are numerous occurrences of natural gas in Italy, the more important being at Velleia, Barigazzo, Porretta and Sassuolo. In Emilia alone there are 500 "wells," one of which, viz., that at Sassuolo, has been known since the time of Pliny. The present consumption of natural gas is only about 9 million cb. m. annually, and although the gas contains 97 per cent. of methane, and has a calorific value of about 8000 cal. per cb. m., practically no exploratory work has been done; the presence of asphalts, bitumens and hot springs suggests that large quantities may be awaiting discovery.—(*G. Chim. Ind. App.*, Oct., 1921.)

The Explosion at Oppau.—The Government commission of inquiry into the Oppau disaster sat at Ludwigshafen on December 5 and 6. In evidence given by experts it was denied that the works management of the Badische Anilin- und Sodafabrik was aware that ammonium sulpho-nitrate was liable to explode. Prof. Eskales, of Munich, who believes that the mixed salts are explosive and that the catastrophe was due to blasting, pointed out that the analyses to determine the explosibility had been made on freshly-prepared material and not on stored material which had set hard, and the latter had been found to contain more nitrate than the former. After lively discussion it was resolved to take further evidence.—(*Chem.-Z.*, Dec. 17, 1921.)

Developments at the Bayer Co.'s Works.—On the occasion of a recent visit by members of the International Labour Conference to the Bayer factories at Leverkusen, the managing director, Dr. Duisberg, announced that the firm was about to produce various new dyestuffs, substances for destroying moths, weeds and vermin, and new pharmaceutical chemicals. After researches extending over 11 years at the Elberfeld works, a substance had been discovered which, it was believed, would be a certain specific for sleeping sickness. As an illustration of the thoroughness with which German munitions plant was being destroyed, he stated that in Leverkusen alone plant worth 50 million gold marks had been destroyed at the instance of the Inter-Allied Commission of Control, and that the work of destruction cost 25 million mk.

Labour-Recruiting in the German Heavy Chemical Industry, 1913-1921.—Hitherto the supply of labour for the flourishing heavy chemical industry has been obtained (a) through advertisements, (b) by outside agents, (c) through the general labour bureaux, and (d) through the introduction of one worker by another. Experience has shown that advertising is only useful when men are required for special work, for when unskilled workers or fitters, obtained in this way, are engaged, they usually leave after a short time. Only a few workers have been obtained through agents, and this method was only introduced on account of the great shortage of labour which began in 1916. Much labour has been recruited through the Labour Bureaux, but only a very small proportion has settled in the trade. The chief Labour Bureaux concerned are those at Frankfurt a.M. (which supplied most), Strassbourg, Würzburg, Aachen, Metz, Essen, Hannover, Bielefeld and Düsseldorf.

The best method has been found to be through recommendation by the firm's own people, who have been paid a premium for this service; men thus obtained have always remained. Premiums have been paid in three instalments, the first after the new man had stayed four weeks, the second after the twelfth week, and the third on completion of the year. These terms were shortened latterly. The success of method (b) is due to the circumstance that it is obviously to the interest of the agents that the men introduced should remain as long as possible so that the full premium may be obtained, and that of (d) to the fact that most of the recruits are personally known as suitable.

Proposed Increases of Capital in the German Dye Industry.—The companies belonging to the "Interessengemeinschaft" intend to take advantage of the high share-values now ruling by increasing their combined capital by 100-150 million marks nominal and so obtaining the necessary money for reconstructing the works at Oppau. The increases in capital of the seven constituent firms of the I.G. which were made in April, 1921, were on account of the ammonia-factory at Merseburg, as well as for covering increased costs of raw materials and production. Recent increases in share capital are given below, in millions of marks:—

	Jan., 1920.	Share capital. Spring, 1921	New.
Badische	252	430	470
Bayer, Leverkusen ..	252	430	470
Höchst	252	430	470
Casella	113	185	—
A.-G. für Anilin-fabrikation	68	146	159
Griesheim-Elektron ..	63	108	118
Weiler-ter-Meer ..	23.30	33.33	35-070
Totals	1043.30	1762.33	—

"Phosphates, 1913-1919," issued by the Imperial Mineral Resources Bureau (pp. 72. 2s.) is a valuable repository of statistical and other information concerning the world's production and consumption of phosphates during the war-period. Much of the matter contained in it has already been given in outline in these columns, notably by W. Packard in the issue for August 15, 1921, and the following notes are added as supplementary thereto.

Considerable quantities of apatite, containing from 31.87 to 41.54 per cent. of phosphoric acid, were produced in Canada prior to the development of the deposits in the United States, but latterly only a few hundred tons per annum have been mined from the abundant supplies situated in the mica belt in Ottawa County, Quebec. Low-grade coprolitic beds occur in Quebec and Nova Scotia, and there is a bed of low-grade, hard, black phosphate in Alberta which is of very doubtful commercial value at present. The chief manufacturing centre is Buckingham township, Que., where American phosphate is converted into fertilisers, phosphorus and its compounds.

The Island of Redonda, Leeward Islands, contains deposits of aluminium phosphate occurring in veins up to 2 ft. thick in the volcanic rock of which the island is composed. Considerable quantities have at times been shipped to the United States.

A bed of black phosphatic nodules, estimated to contain 8 million tons, occurs in Pondicherry, British India. The nodules, which contain 56-59 per cent. of tri-calcium phosphate, are very irregularly distributed and were worked unsuccessfully some years ago. Phosphatic nodules are also found in the Trichinopoly district, and the Department of Industries in Madras is considering the question of exploiting them. Another deposit is situated in the Dehra Dun district, United Provinces, and apatite is found abundantly near Kodarma, in Hazaribagh, near Jothvad, in Bombay, and in the manganese mines of Garbham, Ramabhadrapuram, and Devada, in Madras.

Numerous deposits of mineral phosphate occur in Australia, but not many of them are worked and the country relies upon important high-grade rock for the manufacture of superphosphates. The chief factories are situated at Wallaroo, Port Adelaide, Torrens-ville, and Cockle Creek.

Prior to the war no deposit of commercial importance was known in Germany, but in 1918 one was found close to Amberg, near Nürnberg, in Bavaria, which is estimated to contain the equivalent of 35 per cent. of tri-calcium phosphate. [The output from this source is now about 600 m.t. per month and it could be considerably increased.]

Very important deposits occur in northern Russia in the provinces of Vladimir, Krostrom, Viatka,

and Yaroslav, and in southern Russia in Podolia and Bessarabia, but only the latter, which are said to contain 80 million t. of phosphate rock, were worked before the war, the mineral being sent to Poland for conversion into superphosphates. There are also numerous other deposits, but the combined production from all was only 25,000 t. in 1913 and 15,000 t. in 1914. Since 1919 the Soviet Government has made some attempt to provide the peasants with superphosphate produced at factories situated in Petrograd, Kineshma, and Nijni Novgorod.

An English company is working the extensive deposits of phosphate in Curaçao and Aruba, two islands off the coast of Venezuela. The mineral is very high-grade, containing 80–85 per cent. of tricalcium phosphate, and less than 1 per cent. of combined iron oxide and alumina; it is, however, very hard and therefore difficult to work. The maximum output was attained in 1914, viz., 96,000 t.

The value of the important occurrence in the island of Rasa, Japan, is greatly reduced by the high content of iron oxide and alumina, but under the Peace Treaty Japan has obtained control of important deposits on Angaur Island, on several of the Marshall Islands, and on Fais Island in the West Caroline Group.

Picric Acid as Antiseptic.—In a short article in the November issue of the *Journal of Industrial Hygiene*, Dr. A. G. Boldue, of New Jersey, states his experience of the use of picric acid for treating minor cuts, severe lacerations, punctured wounds, compound fractures of the hands and feet, and other cases common in industrial plants. He has treated over 4000 cases with a solution containing 5 per cent. of picric acid and 95 per cent. of alcohol, which he has found to be much superior to iodine solution. Picric acid is comparatively cheap, is mildly anæsthetic, stable, non-irritant and non-toxic, accelerates healing, and can be applied to any part of the body, except the eye, with absolute safety. Its one drawback is the tenacity with which it adheres to the skin, and a reagent is required that will remove the stain from the skin as readily as it can be removed from clothing and dressings by washing in water.

Suggested Use of Rubber Latex in Paper-making.—In *The Bulletin of the Rubber Growers' Association* for December, Mr. F. Kaye, of the College of Technology, Manchester, states that many highly desirable qualities, e.g., strength, bursting-strength, and folding resistance, can be imparted to paper by adding rubber latex to the beaten pulp, and that by increasing the amount of rubber in the final product, paper with very exceptional properties can be produced. No additional expense is incurred in the paper-making process, and experimental trials have shown that the time of beating of most kinds of pulp is very considerably shortened. Should this process be adopted, it would provide an outlet for large quantities of rubber, e.g., for strengthening fibres which have hitherto found no extensive application.

Forthcoming Lectures at the Royal Institution.—The arrangements for the new session include the following lectures which will be of interest to chemists:—*Friday Evening Discourses*, at 9 p.m.—Jan. 20. "Soap Films and Molecular Forces": Sir James Dewar. Feb. 24. "The Age of the Earth": Dr. J. Joly. Mar. 10. "Problems in the Variability of Spectra": Dr. T. Merton. Mar. 17. "The Pigments and Mediums of the Old Masters": Prof. A. P. Laurie. Apr. 7. "Evolution of the Elements": Sir Ernest Rutherford. *Afternoon Lectures*, at 3 p.m.—Jan. 17, 24. "Physiology as applied to Agriculture": Dr. F. H. A. Marshall. Feb. 16, 23. "Dyeing: Ancient and Modern": Prof. A. G. Perkin. Mar. 4, 11, 18, 25, Apr. 1, 8. "Radio-activity": Sir Ernest Rutherford.

PERSONALIA.

Prof. Paul Pfeiffer, of Karlsruhe, has been appointed to succeed Prof. R. Anschütz in the chair of chemistry at Bonn University.

Mr. J. Griffith has been appointed head of the department of agricultural chemistry in the University College of North Wales, Bangor.

The American Section of this Society has awarded the Perkin Medal to Mr. William M. Burton, of the Standard Oil Co. of Indiana. The presentation was due to be made on January 13, in the Chemists' Club, New York.

Dr. R. W. Woodward, physicist and chief of the section of mechanical metallurgy of the Bureau of Standards, U.S.A., has resigned in order to become chief metallurgist to the Whitney Manufacturing Co., of Hartford, Conn.

The house in which Louis Pasteur was born in Dôle, Jura, is to be purchased with funds provided by Mr. John D. Rockefeller, and converted into a museum and library to hold Pasteur's original manuscripts and other scientific literature.

Prof. J. C. Irvine, principal of the University of St. Andrews, has been appointed president of Section B (Chemistry) of the British Association for the meeting to be held in Hull from September 6 to 13, 1922. Prof. G. H. Hardy will be president of Section A (Mathematics and Physics).

Dr. E. Fox Nicholls, who was appointed president of the Massachusetts Institute of Technology in June, 1921, has resigned office owing to serious ill-health. His duties are to be taken over by Dr. Elihu Thomson, of Swampscott, Mass., consulting engineer to the General Electric Company.

The Paris Academy of Sciences has awarded the Montyon prize to the late Lucien Ville for his work on poisonous gases; the Jecker prize to J. E. Léger for researches in organic chemistry; the Berthelot prize to Mme. Ramart-Lucas for work in organic chemistry; and the Houzeau prize to P. Jolibois for researches in physical inorganic chemistry.

On the recommendation of a Joint Committee of the University and the Royal Technical College, Glasgow, the trustees of the Ferguson Bequest Fund have elected Mr. H. Hyman to the Ferguson Fellowship in Applied Chemistry. The Fellowship is of the value of £200 per annum, and tenable for two years. Mr. Hyman will hold it at the Royal Technical College, Glasgow, and will carry out research in metallurgy under the direction of Prof. J. H. Andrew.

The list of New Year honours includes the names of Prof. C. S. Sherrington, president of the Royal Society, who is appointed a Knight Grand Cross of the Order of the British Empire (G.B.E.); of Prof. G. E. Cory, professor of chemistry in the Rhodes University College, Grahamstown, South Africa, upon whom a knighthood is conferred; of Mr. Joseph Watson, chairman of Joseph Watson and Sons, Ltd., soap manufacturers, who is raised to the peerage; and of Mr. Edward Packard, of Ipswich, who becomes a knight.

The trustees of the Beit Memorial Fellowship for Medical Research have recently awarded seven fellowships of the annual value of £400 each, including the following three to workers at the Lister Institute:—Mr. H. D. Kay, for research into the degradation of carbohydrates and allied substances by micro-organisms; Dr. H. Goldblatt, for research on the quantitative relation of fat-soluble-A-deficiency to the development of experimental rickets; and Dr. E. M. Luce, for research on accessory food factors, with special reference to the relationship of ductless glands to calcium metabolism.

The death is reported of Prof. Tassart, of the Ecole des Mines, Paris, a specialist in petroleum technology; of Albertus Vogt, aged 71 years, who was the first to draw public attention to the deposits of rock phosphate in Florida; and of Senator Ciancician, professor of chemistry in the University of Bologna, Italy.

Mr. Arthur H. Gallun, of A. F. Gallun and Sons, Milwaukee, who died on November 9, 1921, did valuable pioneer work in urging the application of chemistry to the manufacture of leather. He endowed research at Columbia University, with the proviso that the results should be published freely, and lately was urging American tanners to establish there a department of leather industry.

We also regret to record the following deaths:—Dr. Harry Ingle, of Leeds, on December 4, aged 52 years; Mr. H. R. Augustus Oertling, managing director of Messrs. L. Oertling, Ltd., balance-makers, at the age of 73; Sir Thomas Barclay, managing director and chairman of Messrs. Southall Brothers and Barclay, Ltd., fine-chemical manufacturers, of Birmingham, aged 82 years; Sir G. Sims Woodhead, professor of pathology in the University of Cambridge, in his 67th year; Mr. C. E. Cassal, formerly public analyst for Kensington, Westminster, Battersea, and parts of Lincolnshire, and for 15 years editor of the *British Food Journal*; and Sir William H. Tate, formerly chairman of Henry Tate and Sons, sugar refiners, of Liverpool and London, in his 80th year.

LEGAL INTELLIGENCE.

APPEAL TO INCLUDE GAS MANTLES IN THE LIST OF ARTICLES DUTIABLE UNDER THE SAFEGUARDING OF INDUSTRIES ACT.

On December 3, Mr. Cyril Atkinson heard the claim put forward by the British Association of Incandescent Gas Mantle Manufacturers and by manufacturers of thorium salts that gas mantles had been improperly excluded from the list of dutiable articles under Part I. of the Act. The Board of Trade and the National Gas Council opposed the claim.

Mr. Terrell, for the complainants, contended that a gas mantle consisted solely of compounds of thorium and cerium, and as the nitrates of these metals were used almost exclusively for that purpose, the Legislature must have intended to include gas mantles when specifying thorium and cerium nitrates. The Act was meant to protect "key" industries, which he defined as capital industries producing material for many other industries, whether the country were at war or not. Section 8 of the Schedule specified among the goods chargeable with duty "metallic tungsten, ferro-tungsten, and manufactured products of metallic tungsten, and compounds (not including ores or minerals) of thorium, cerium, and other rare-earth metals." The referee would have to put a construction on the word "compound," which might connote a chemical compound, a mechanical mixture, or an article of which only a part was dutiable. He submitted that the word as used in the Act covered all three meanings. Further, it would be necessary to define the term "fine chemicals" in the last section of the Schedule; the term indicated great purity, and thorium and cerium nitrates had to be very pure for use in mantle-manufacture. The Act also stated that duty should not be levied if a dutiable constituent of the article had lost its identity in the course of manufacture; that consideration did not

apply to the oxides of thorium and cerium present in the mantle. He contended that the mantle as a whole was liable to duty.

After expert evidence had been given by Mr. H. Ballantyne, Mr. C. B. Grylls, of the Customs and Excise Department, stated that the practice of his Department was to charge duty only on that portion of a finished article which was dutiable.

Mr. C. S. Garland (managing director of Lighting Trades, Ltd.) said that the manufacture of gas mantles and thorium nitrate in this country would cease if the present foreign importations were allowed to continue. Taking 1000 marks as equal to £1, the present price of German mantles in this country was 36s.—38s. per gross, and the English wholesale price was 60s. per gross. The 33½ per cent. duty would not be adequate at such prices, but if protection were also granted under Part II. of the Act, the industry could be saved.

Mr. Edmund White (managing director of Thorium, Ltd.) said that his works were designed to produce 40,000—50,000 kg. of thorium nitrate per annum, but owing to importations of foreign gas mantles the present output was only 20,000 kg.

Mr. J. Hunter Gray, for the National Gas Council, after referring to the increase in price which would inevitably follow the taxation of gas mantles, said that in the Financial Resolutions which preceded the introduction of the Bill the Chancellor of the Exchequer had definitely stated that gas mantles were to be excluded, and also that manufactured products of thorium, cerium, and other rare-earth metals were not mentioned in Section 8 of the Act (*cf. s.*). In the present case the referee had only to consider whether gas mantles had to be taxed as manufactured articles or not.

In his decision, given on December 10, Mr. Cyril Atkinson said that, in his opinion, the word "compound" in the Schedule was not used in the scientific sense, and that it also covered mechanical mixtures. He could not see how the importation of a mechanical mixture of dutiable articles in the form of a mantle could make any difference to the liability to duty. The presence in the Schedule of the words "and manufactured products of metallic tungsten" following "metallic tungsten" and the absence of corresponding words referring to compounds of the rare-earth metals led him to the conclusion that it was impossible to include gas mantles in the list of dutiable goods; but it was quite clear that the most material part of the gas mantle consisted entirely of substances which were liable to duty, and he therefore thought that words should be added to the list to make it clear that mechanical compounds of oxides or nitrates of thorium and cerium in the form of mantles are subject to duty; but it was not for him to say how that duty was to be collected. He directed that there be added to the appropriate list the words "mechanical compounds of nitrates of thorium and cerium and of oxides of thorium and cerium in the form of mantles or forming part of mantles used in incandescent lighting." He would not award costs either in this case or in subsequent cases unless there were special circumstances.

On December 21 the matter was again brought up, as the Customs Authorities were in doubt whether the duty should be levied upon the value of the raw materials before or after they are worked up to be usable in the form of mantles. The referee said that he had definitely declined to determine the manner in which the duty was to be levied. He proposed to alter the words to be added to the list to: "Mechanical compounds of nitrates of thorium and cerium and of oxides of thorium and cerium, being ingredients or forming part of mantles used in incandescent gas lighting"; and he left it open to Mr. Terrell, who had objected to any alteration, to ask him to state a case for the opinion of the court, in accordance with Section I. (1) of the Act.

REPORTS.

FUEL FOR MOTOR TRANSPORT. *Second Memorandum by the Fuel Research Board.* Pp. 16. Department of Scientific and Industrial Research. London: H.M. Stationery Office, 1921. Price 6d.

The provision of an Empire-produced liquid fuel alternative to petrol continues to be of great importance because the consumption of the latter is increasing and the British Empire is responsible for only 2·5—3 per cent. of the world's production of petroleum. The motor spirit imported into this country amounted to over 207 million galls. in 1920 and to 216 million galls. in the first ten months of 1921. (*cf.* J., 1920, 277 n.) The only methods of producing alcohol which are of proved economic value are those which utilise sugar obtained from the plant or from starch, and the possibility of manufacture on a large scale from materials grown in this country is remote. The following list shows the average yields of alcohol obtainable from the more important raw materials.

Material.	Yield of 95% alcohol per ton. Gallons.	Material.	Yield of 95% alcohol per ton. Gallons.
<i>Containing sugar :—</i>		<i>Containing other carbohydrates :—</i>	
Mangolds	10	Artichokes, Jerusalem ..	19
Molasses, beet ..	64	Barley	72
Molasses, cane ..	69	Cassava	35
Nipa-palm sap ..	11	Maize	83
Sorghum, sweet ..	12·5	Oats	65
Sugar-beet	17	Potatoes	20
Sugar-cane	20	Potatoes, sweet ..	35
Sugar, raw	139	Rice	88
Sulphite lyes (per 100 galls.)	7-8	Rye	77
<i>Miscellaneous :—</i>		Sisal	15·5
Peat	15	Sorghum grain ..	85
Sawdust and wood waste ..	20	Wheat	80
Acetylene	510	Zauia palm	13
Ethylene	475		

It may be possible to use the molasses resulting from the refining of beet sugar grown in this country if it does not prove more valuable for feeding cattle. Experiments have been conducted on the cultivation of sugar mangolds and Jerusalem artichokes. One variety of beet, *betterave de distillerie à colet vert*, gave yields equivalent to 2·28—3·53 t. of sugar per acre in 1920, and should these results be confirmed in 1921 it might be grown on contract by farmers as a root rotation crop, as sugar-beet is being cultivated at Kelham. The yields of artichokes obtained were equivalent to 1·35—3·04 t. of sugar per acre, and there is some prospect of converting the stalks into a resistant cellulose suitable for the manufacture of nitrocellulose. It is not likely that the ordinary farmer would grow artichokes as a field crop, but means for dealing with the crop deserve consideration in view of the ease with which it may be raised, under poor conditions, to provide a home-produced supply of two essentials for the manufacture of explosives.

Limited quantities of alcohol might be produced in this country by the importation of molasses up to the capacity of existing distilleries, which is 8—9 million galls. of molasses per annum; although only 100 galls. of 95 per cent. alcohol is obtained from 250 galls. of molasses, this course would be more economical than the erection of new distilleries to deal with the molasses where produced. In parts of the Empire where molasses is available or where conditions are favourable to the cultivation of such substances as cassava, sweet potatoes, and yams, which give a high yield of starch per acre, alcohol might be produced to meet local needs. In Canada the waste sulphite-liquors could be utilised; enormous quantities of waste wood are also available but the processes for converting it to alcohol are not yet commercially successful. Natural growths such as sorghum, cassava, and palms yielding sugar or starch occur in parts of Australia in

addition to quantities of cellulosic materials. The utilisation of brown coal in Australia and of water power in Canada for the production of electrical power opens up the possibility of manufacturing calcium carbide and converting it into alcohol or into fertilisers for special vegetable crops. Conditions are particularly suitable in Fiji for utilising molasses and growing cassava. In South Africa 1·25 million galls. of "Natalite" (a mixture of alcohol and ether) was produced in 1920, but this was far short of local requirements. Cereals and potatoes might be grown cheaply in excess of food requirements in Northern Rhodesia. Cultivation of the sugar-cane in Ceylon has been recommended, but as molasses is already imported for conversion into "arrack," the possibilities of producing power alcohol are very limited. In Mauritius, British Guiana, and the West Indies, alcohol in excess of local requirements could be obtained by increased utilisation of molasses. The Fuel Research Board is in constant touch with the Dominions and Colonies and with interested parties concerning possible supplies of raw materials.

No practicable process has yet been discovered for converting cellulosic materials available in tropical climates into alcohol, but it has been established that cellulose can be broken down by bacterial action into glucose and cellobiose. These products are, however, converted into non-fermentable substances as the action proceeds. Present research is being directed towards the selection of the most suitable organism and the fixation of glucose and cellobiose as produced. A process for producing alcohol from ethylene contained in coal gas and coke-oven gas has not yet been developed on a manufacturing scale, but even if the attempt proves successful it is doubtful if it would be profitable to produce alcohol at the expense of the calorific value of the coal gas.

Under the Finance Acts of 1920 and 1921, alcohol to be used for power and industrial purposes is free from all duties except the preferential duty on spirit from foreign countries. In view of the regulations now in force experiments have been carried out to determine the most suitable mixtures of methylated spirits, benzol, and petrol. It is concluded that, to obtain a mixture homogeneous at 0° C., not more than 40 per cent. of petrol can be used, the alcohol content may be from 20 to 42 per cent., the benzol varying correspondingly between 40 and 18 per cent. Investigations are proceeding with the object of finding simpler and cheaper denaturants.

THE EFFICIENCY OF LOW-TEMPERATURE COKE IN DOMESTIC APPLIANCES. By DR. M. W. FISHEN-DEN. *Fuel Research Board, Department of Scientific and Industrial Research. Technical Paper No. 3.* Pp. 35. London: H.M. Stationery Office. Price 9d.

In this paper particulars are given of tests carried out to ascertain the relative efficiencies of ordinary bituminous coal and cakes of coke obtained by low-temperature carbonisation, when used for heating rooms, water, and for cooking in various types of domestic appliances. The calorific value of the coal used in most of the tests was 14,700 B.Th.U. per lb., and that of the coke about 12,500 B.Th.U. per lb. In most of the appliances tested, the coke yielded a greater proportion of its total heat of combustion, both for radiation and for water-heating, than bituminous coal. Moreover, the greater the efficiency of the appliance tested, the greater was the relative advantage of the coke over the coal. This is clearly shown in the following table which gives the percentage efficiencies afforded by the use of coal and coke-cakes in various types of domestic grates, some of which were provided with appliances for furnishing a supply of hot water for domestic purposes.

Heat Radiation.			Water Heating.		
Grate.	Mean Efficiency.		Grate.	Mean Efficiency.	
	Coal.	Coke-Cakes.		Coal.	Coke-Cakes.
"D"	24.2	30.8	"G"	32	42
"A"	19.5	24.0	"F"	17.3	20.7
"E"	17.3	19.9	"H"	15.2	17.4
			"J"	13.1	14.5

Details of the various types of grates tested are given in the paper.

For heating ovens, coke-cakes compared rather less favourably with coal, roughly about equal numbers of heat units being required to give similar results. The advantage of coke-cakes is due largely to radiation effects and is most marked when the distance between the fuel bed and the oven is small. In certain cases the greater flame-contact afforded by bituminous coal more than counterbalances the greater radiation from the coke. It is pointed out that the tests were carried out with ovens and boilers specifically designed to burn coal, and it is anticipated that in appliances specially designed for the combustion of coke obtained by low-temperature carbonisation the superiority of this fuel might be considerably emphasised.

The ordinary kitchen range is condemned as an inefficient and ill-designed appliance. Practical water-heating tests carried out therewith gave an efficiency of from 13—19 per cent. of the heat value of the fuel employed, compared with the 30 per cent. efficiency yielded by an independent boiler fired with coal, and 40 per cent. with coke-cakes. Radiation from kitchen ranges of various types amounted at the best to only about 10 or 11 per cent. of the fuel used. It is concluded that having regard to the many serious aspects of the smoke problem, the use of the independent coke-fired boiler should be popularised for domestic hot-water supply. Combining such service with the use of gas for cooking, the total cost would be about the same as that for coal in the ordinary kitchen-range.

REPORT ON THE ECONOMIC AND COMMERCIAL CONDITIONS OF VENEZUELA, DATED SEPTEMBER, 1921. By H. D. BEAUMONT, H.B.M. Minister, Caracas. Pp. 28. Department of Overseas Trade. London: H.M. Stationery Office. 1921. Price 6d.

Apart from cultivated crops and livestock, the natural wealth of Venezuela resides mainly in balata, rubber, copaiba, tonka beans, tanning barks, timber, gold, asphalt, coal, copper, and petroleum. Gold-mining is not flourishing at present, and the output of gold fell from about 30,660 oz. troy in 1919 to about 26,880 oz. in 1920, to which the Gold Fields of Venezuela, Ltd., the chief producer, contributed 4507 oz. troy. The export of asphalt declined from 45,913 tons in 1919 to 22,000 t. in 1920, but the output of coal, from the State mines of Naricual, improved by 41.9 t. to 29,708 t.; a briquetting plant has been imported and better transport facilities for coal are being provided. No copper has been produced during the past two years by the South American Copper Syndicate (Aroa); a few thousand tons of ore and matte have been shipped and a smelter for treating low-grade ore is being erected. Many British and American companies are exploring for petroleum, but only the Caribbean Petroleum Co. (controlled by the Anglo-Saxon Petroleum Co.) is actually producing; its output in 1920 was 69,539 t. of crude oil (45,913 t. in 1919), and refining is carried out at San Lorenzo on Lake Maracaibo. Manufactures are but little developed; cotton textiles, sole leather, common

soap, candles, cheap bottles and table glass, cement, coarse paper, tiles, beer, and matches are produced for the home market.

The war had little effect on Venezuelan trade save to direct it more towards the United States. After the armistice there was a short period of stagnation, but owing to the world scarcity of goods trade soon revived and until the summer of 1920 the principal exports—coffee, cocoa, and hides—were selling at record prices. Thereafter prices fell, business practically ceased and up to August, 1921, there were very few signs of recovery. Exports during 1920 were valued at 170,632,844 bolivars (bolivar=94d. at par, now 10.4d.), of which the United States took 46.8%, Holland and Curaçao 14.6%, and the United Kingdom and Trinidad 14.2%. Imports were supplied mainly by the United States (50.8%) and the United Kingdom (23.3%); their value was 302,291,378 bol., as compared with 139,806,708 bol. in 1919 (U.S.A. 63.9%, U.K. 24.6%). Imports from the United Kingdom consist mainly of cotton textiles, but British cutlery and crockery are in good demand, and the supply of drugs (valued at 12 million bol. in Jan.-June, 1920) and perfumes could easily be increased. The total value of the country's trade was about £18,000,000 in 1919 and £19,000,000 in 1920; in the former year exports exceeded imports by nearly £5,000,000, in the latter the position was reversed, so that the demand for foreign goods is restricted at present.

GENERAL REVIEW OF THE CONDITIONS AND PROSPECTS OF BRITISH TRADE IN INDIA DURING 1919-20, REVISED TO OCTOBER, 1921. By T. M. AINS-COUGH, H.M. Senior Trade Commissioner in India and Ceylon. Pp. 362. Department of Overseas Trade. London: H.M. Stationery Office. 1921. Price 5s. net.

During the past two years the United Kingdom has made a remarkable recovery of its share in the trade of British India; that share is now 44 per cent. of the total trade, i.e., 3 per cent. more than before the war, but whereas the share of the import trade has risen from 46 per cent. in 1918-19 to 61 per cent. in 1920-21, compared with 64 per cent. in 1913-14, the share of the export trade is still very low, 22 per cent. against 21 per cent. in 1913-14. England's chief competitors for the Indian import trade are the United States, whose share fell from 12.1 per cent. in 1919-20 to 10.5 per cent. in 1920-21, Japan (7.9 per cent.), Germany, whose shipments are steadily increasing, and Belgium, which is underselling British steelmakers and regaining its trade in window-glass.

Imports of iron and steel have increased remarkably but are still well below those of 1913-14. The United Kingdom is well ahead of all other nations in this trade, and also in the supply of aluminium. The largest aluminium firm in England is about to erect works in India. Imports of lead ore, pig lead, block tin, and spelter are almost entirely of British origin.

The following table shows the value and origin of imported chemicals, other than fertilisers and medicines:—

	1913-14.	1918-19.	1919-20.
Total value	£676,506	£1,661,710	£1,610,503
Origin:—			
United Kingdom	74.7	63.2	75.8
Japan	1.5	24.3	11.9
Italy	5.2	1.2	2.0
United States	0.3	5.7	6.6
Germany	12.4	—	—
Other countries	5.2	5.0	3.7

For 1920-21 the value was £2,661,346, and if detailed statistics were available they would probably show that the British share had further increased.

Nitric, sulphuric, carbolic, and tartaric acids (total value £146,157 in 1920-21) are derived almost exclusively from Great Britain, which also supplies about 80 per cent. of the bleaching materials (£133,000), 50 per cent. of the potassium compounds (£75,074), and 93 per cent. of the disinfectants (£67,000 in 1919-20). A large British company has a virtual monopoly of the trade in soda compounds, valued at £411,910 in 1920-21, and roughly one-half of the import consists of soda crystals and soda ash. Imports of dyes have been as follows:—

Description:—	1919-20.		1920-21.	
	1000 lb.	Value. £	1000 lb.	Value. £
Allizarin dyes ..	2,027	220,740	3,883	732,368
Aniline dyes ..	4,098	1,103,565	6,738	2,631,033
Other dyes ..	—	—	9	2,068
Origin:—				
U.K. ..	3,552	534,648	3,467	940,268
Germany ..	90	8,007	3,653	1,169,670
Belgium ..	41	15,169	392	133,065
Switzerland ..	516	275,369	318	150,610
U.S.A. ..	1,918	546,449	2,013	758,552
Other countries ..	8	4,663	787	213,904
Totals ..	6,125	1,384,305	10,630	3,360,969

Great progress has been made by the British dyemakers, who are making every effort to capture the trade, but competition from Germany, the United States, and Switzerland is keen. The soap trade is almost entirely in British hands and the volume of imports is steadily increasing. In the supply of paints and painters' materials, the United Kingdom has regained the lead, despite American competition in white lead, high-grade paints, and turpentine; Japanese competition under this head will probably decline, but that from Indian paint and varnish works is likely to be severe. Turpentine is already being made in the country in increasing quantities.

The trade in drugs and medicines increased in value from £977,962 in 1918-19 to £2,112,829 in 1920-21, the British share being 42 per cent. in 1919-20, and the United States and Japan coming next with 12 per cent. each. British manufacturers also lead in imports of leather and leather goods, but are losing ground to the United States and France in manufactured rubber goods. Japan is the chief source of imported earthenware and porcelain and has entirely replaced Germany, Holland, and Belgium as a source of cheap earthenware. A large proportion of the glass and glassware also comes from Japan, although the United Kingdom still supplies the finer qualities of plate and window glass. Imports of glass in 1920-21 rose in value to £3,376,184, of which £1,413,442 represented beads and bangles from Japan. The trade in leather and metal polishes is largely held by British manufacturers, and also that in explosives, oilcloth, and engine- and boiler-packing. Imports of coal, coke, and patent fuel improved to 85,993 tons in 1920-21, but were only 16 per cent. of those in 1913-14. The Standard Oil Co. of New York is the leading importer of kerosene; the trade in imported fuel oil (Persia and Borneo) is almost entirely in British hands, the Asiatic Petroleum Co. is competing more and more, and the Anglo-Persian Oil Co. is making remarkable progress. Imports of vegetable oils were valued at £86,638 in 1919-20 and at £247,620 in 1920-21, linseed oil being much the largest item. All the linseed oil imported in the former year came from England, but India will no doubt eventually crush and refine her own. The oil-mills of the Tata Oil Mills Co., Ltd., erected at Ernakolam in Cochin State, have done very little so far. The United Kingdom provides most of the imported animal oils, of which fish oil represents three-quarters; this trade is, however, declining owing to the increased production in Madras. Essential oils are imported in small quantities (£72,820 in 1919-20 and £167,155 in 1920-21); the trade is very evenly distributed between England, France, and Japan, the last two having replaced

Germany, which was formerly the principal source of supply. Imports of salt have risen in value from £1,554,018 in 1918-19 to £2,281,346 in 1920-21, and although British shipments have increased, they are still much below the pre-war figures; the trade with Aden and Somaliland has grown remarkably.

The question of an All-India Chemical Service, which was reported upon in 1920 by a special committee under Prof. J. F. Thorpe (*cf. J.*, 1920, 167 n) has not yet been settled. It was considered at a conference, held in Simla in May, 1921, by provincial ministers and directors of industry, who decided to make further local inquiries and to postpone a definitive conclusion. Opposition to the creation of further Imperial Indian Services over which the local governments have no control appears to be growing in the provinces.

The report also contains an extended reference to the Indian Institute of Science at Bangalore.

GOVERNMENT ORDERS AND NOTICES.

IMPORT AND EXPORT LIST.—The alterations in this list which came into effect on January 1, 1922, are detailed in the *Board of Trade Journal* for January 5; they include, *inter alia*:—

Old headings omitted:—Soy, when containing molasses or other sweetening matter; oak, chestnut, and quebracho barks for tanning. *New headings added:*—Barks for tanning—wattle bark; mixed lubricating oils. *Sub-divisions omitted:*—In the Export List the following distinctions have been omitted: Silica sand (unground) and other sands (unground); esparto fibre and other vegetable fibres for paper-making. *Headings amended or rearranged:*—The scope of the heading "Sulphate of alumina (including alum)" will be restricted to "Sulphate of alumina (including potash alum and ammonia alum)."

A revised issue of the list will be on sale shortly.

PROHIBITED EXPORTS.—The same issue of the *Board of Trade Journal* contains a list of goods of which the export is prohibited from the United Kingdom by Royal Proclamations or Orders-in-Council, and which includes:—Cocaine, diamorphine, ecgonine, morphine, opium, and their salts; explosives (with certain exceptions); fuses other than safety fuses.

The Board of Trade (Licensing Section) announces the issue of a new Order-in-Council, the Arms Export Prohibition Order, 1921, dated December 13, 1921, and the revocation of a previous Order. The goods affected include explosives, with certain exceptions.

SAFEGUARDING OF INDUSTRIES ACT.—*Part I.* A complaint has been received from the Manufacturing Confectioners' Alliance that cream of tartar, tartaric acid, and citric acid have been improperly included in the lists of articles dutiable under Part I. of the Act. The complaint will be heard by the official referee on January 21 and interested parties should communicate immediately either with the Alliance or with the Board of Trade.

ALTERATION IN BELGIAN PATENT LAW.—By a decree of November 4, 1921, article 13 of the Belgian Law of October 11, 1919, which provides that the period of the war shall not be taken into account in reckoning the duration of patents, has been applied to nationals of the United Kingdom.

PROPERTY IN RUSSIA.—A translation of a decree of the Council of People's Commissaries, regulating the requisition and confiscation of property of individuals and companies in Russia, is given in the *Board of Trade Journal* for December 29 last.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for December 22, 29, and January 5.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials.	Reference number.
Canada	Rubber and balata belting	551
"	Lithopone, salt cake	552
"	Drugs, perfumes, soaps, package dyes	3
"	Oils, greases, <i>degras</i> , rapeseed, castor and linseed oils	5
"	Sulphuric acid, sal ammoniac, sodium phosphate, potassium chloride, calcium chloride, caustic soda	•
South Africa ..	Cresote (tender for)	7497 E.D./P.N.
"	Varnishes (tender for)	7660 E.D./P.N.
Germany	East Indian klips, sheep and goat skins	14
Greece	Steel rolling-mill products, powder, brass sheets	567
"	Matches (tender for)	6811 F.E./P.N.
Italy	Raw materials and semi-manufactures used in the textile, rubber, paper, and china industries	16
Spain	Chemicals, paints, varnishes, pitch	573
"	Black and galvanised sheeting, tinplate	574
"	Sheet iron, copper, brass, rock phosphate	575
Switzerland ..	Cod-liver oil and allied products	19
"	White enamel for watch dials	20
Egypt	Greases, paints, disinfectants, bleaching powder, cement	12
United States ..	Metals, metal products	581
"	Chamois leather	13371/P.W.S.C.2
Brazil	Heavy chemicals for the textile, soap, glass, match and sugar industries	23
Chile	Electric lamps, ingot tin and lead, steel and iron tubes (tender for)	5149 F.L./P.N.
Cuba	China, stoneware, porcelain	24
Mexico	Earthenware	585
Peru	Soaps, perfumes	586

* High Commissioner for Canada, 19, Victoria Street, S.W. 1.

MARKET SOUGHT.—A Lisbon firm offers to sell ambygonite mines in Portugal and will send quotations and samples to firms that would consider the purchase of at least 10-ton quantities [559].

CUSTOMS. TARIFF. EXCISE.

Australia.—Amendments have been made in the tariff rates for lead arsenate, sensitised blue-print and heliographic paper and fabrics, etc.

Belgium.—The customs tariff is to be revised.

Bulgaria.—A proposed new tariff has been presented to the Legislature.

Cameroons.—As from November 1, 1921, the Nigerian customs tariff is applied to the Cameroons.

China.—Revision of the tariff is under discussion.

Denmark.—A supplement to the issue for December 29 contains a translation of the proposed new customs tariff, by which duties are to be levied on an *ad valorem* basis. Duties on "luxury" goods

are to be increased, but raw materials and semi-manufactures are to be free of duty or taxed very lightly. In most cases the amount of the proposed duty would be less than that of the present specific duty. Items which it is proposed shall be free of duty include many heavy chemicals, unworked celluloid, vegetable dyestuffs, coal-tar dyes, animal fats, margarine, tanning materials, resins, gums, rubber, asphalt and manufactures thereof, fertilisers, asbestos, metals (with exceptions), raw hides and skins, etc.

The importation of fertilisers and intestines (when not air-dried or salted) is prohibited.

Egypt.—A list of import tariff valuations for iron and steel goods is given in the issue for December 22.

Federated Malay States.—Rules have been made for the issue of licences for the importation of intoxicating liquors, denatured spirits, and petroleum.

France.—Coefficients of increase no longer apply to duties payable on cottonseed oil, sesameum oil, groundnut oil, and solid quebracho extract. A general revision of the "coefficients of increase" is to be undertaken early in 1922.

France and Algeria.—Import duties have been increased on machine iron or steel, iron or steel wire, electric carbons, carbon brushes, etc.

Germany.—Entry permits for goods imported from occupied territory are no longer required for sugar wares, artificial sweetening matter, margarine, fertilisers, etc., but are still necessary for malt, cocoa products, rubber tyres and tubes for vehicles, certain types of machine packing, etc.

Gold Coast.—Imports of opium, morphine, heroin, cocaine and similar drugs must bear a certificate to show that they are required solely for medicinal or scientific use.

Greece.—A new tariff is being considered.

Italy.—Building materials and plant imported for producing articles by new processes or articles not already manufactured in Italy are exempted from customs and *octroi* duty until December 30, 1923.

Goods admitted duty-free under the general customs tariff include certain oilseeds, copra, non-edible animal fats, vegetable fibres, vegetable dyeing and tanning materials, organic manures, raw hides and skins, etc.

Lithuania.—Modifications have been made in the export duties on rapeseed, tanned sheep and goat skins, etc.

Montserrat.—A copy of the Ordinance extending preferential rates of customs duty to goods grown, produced or manufactured within the Empire may be consulted at the Department.

Nigeria.—Solid or pneumatic tyres for motor vehicles will not be imported save under licence.

Peru.—A new customs tariff is being prepared which will give greater protection than the one now in force.

Poland.—Duties leviable on petroleum and petroleum products exported from Poland have been revised.

Portugal.—The exportation of undressed cork is prohibited.

Rumania.—A special duty of 180 lei per 100 kg., in addition to the customs duty of 60 lei per 100 kg., is payable on imported calcium carbide until further notice.

Products now subject to export duty include charcoal, pyrites, lamp black, lead glaze, bauxite, raw and sheet mica, glue, and ground bones.

Spain.—For the time being mineral fuels of all kinds may be exported freely.

The draft revision of the customs tariff is under consideration.

Switzerland.—Import licences are required for prepared manures, leather belting, medicated cotton, cotton waste, serums, vaccines, rennet, and matches.

TRADE NOTES.

BRITISH.

British Industries Fair, 1922.—Seven years have now elapsed since the first British Industries Fair was organised with the object of inducing British manufacturers to undertake the production of goods which had hitherto been imported from enemy countries. The venture proved a success from the start and every succeeding year has emphasised its importance and witnessed some new development. Whereas the Fair of 1915 barely filled the Agricultural Hall at Islington, the stand-fronts in 1922 will measure about $5\frac{1}{2}$ miles. Recently the Fair has been held in three sections, viz., in London, Birmingham, and Glasgow, but in 1922 only the first two sections will be maintained, and the exhibition of chemicals formerly held in Glasgow will be located at the White City, Shepherds Bush. Hitherto only Drugs and Druggists' Sundries have been shown in London.

The trade schedule for the London Section includes:—Glassware of all descriptions; china, earthenware and stoneware; scientific and optical instruments; photographic and cinematographic apparatus and requisites; chemicals, light and heavy; domestic chemical products; drugs and druggists' sundries; perfumery; and dyes. (Address: The Secretary, 35, Old Queen Street, London, S.W. 1.) The chemical exhibits, which will be very comprehensive, will be located in the Chemical Hall, adjacent to the Shepherds Bush entrance to the Fair, and products of the same class will, as far as possible, be shown near one another. Practically all the important home manufacturers will exhibit, including about 50 members of the Association of British Chemical Manufacturers.

Although there will be no chemical section at Birmingham, there will be many exhibits of interest to chemists and chemical manufacturers, such as, paints, colours, and varnishes; metals of all descriptions (excluding precious metals); tubes in copper, lead, brass and steel, and steam- and pipe-fittings; general machinery of all descriptions; brewing and distilling plant; indiarubber goods; weighing and measuring appliances and instruments; and aluminium- and enamelware. (Address: The Chamber of Commerce, 95, New Street, Birmingham.)

This year's Fair will derive additional importance from the fact that extended facilities will be available to overseas buyers under the Government's Export Credit Scheme, particulars of which may be obtained from The Manager, Export Credits Department, 73, Basinghall Street, London, E.C. 2. The Department of Overseas Trade of the Board of Trade has already issued 250,000 invitations to trade buyers in this country, and 15,000, to be followed by a further 33,000, to potential buyers abroad, as well as over 82,000 explanatory pamphlets in nine languages and 5700 showcards.

In conclusion, it should be stated that the Fair is entirely self-supporting and that both London and Birmingham sections will remain open from Monday, February 27, to Friday, March 10, inclusive.

FOREIGN.

The Dutch Bottle-Making Industry.—The manufacture of bottles in Holland is seriously depressed, and an appeal for relief has been made to the Government, as all the factories save three are closed owing to foreign competition, chiefly from Germany, and to the reduced export of Dutch liquors due to taxation in importing countries. Exports of bottles were valued at \$4,861,445 in 1920 and only \$1,036,793 during the first seven months of 1921, as against \$2,260,042 in the same period of 1920. The chief market is Great Britain, followed by the Dutch East Indies, Belgium, and South Africa,

but trade in some of these markets has been lost to Germany and Czechoslovakia. Imports of bottles in 1920 amounted in value to \$818,640, and probably approximated to the same figure in the following year.—(*U.S. Com. Rep.*, Dec. 12, 1921.)

Japan.—The financial situation was slightly better during September, 1921, but although exports of sugar, coal, raw silk, and matches improved during the month there was an adverse trade balance, owing to the loss of markets in South Africa and South America. In the chemical industry it appears that difficulty has been felt in keeping a hold on the home market, as there is a tendency to combine with foreign companies. Thus the Japan Fertiliser Co. has made a 5-year contract with Brunner, Mond and Co., and the Kauto Oxygen Co. an agreement with Samuel and Co. The foreign firms are to provide the necessary processes and assist the Japanese companies in obtaining raw materials. The worst depression is felt by the dyestuff manufacturers, who, unless something is done for them, are faced with the prospect of seeing German imports capture the entire market. In view of foreign competition, copper manufacturers are asking for increased custom duties. Owing to increased demands and short supplies from abroad, sales of iron and steel have been larger, but there has been little activity in the market for other metals. Importation of foreign paper continued and reduced prices were anticipated. The pottery industry was very depressed, and the output in Nagoya fell to about 30 per cent., but the glass industry was in a still worse state. The match industry has recovered in a remarkable way and its prospects are considered hopeful.—(*U.S. Com. Rep.*, Nov. 88, 1921.)

Position and Prospects of Chilean Nitrate.—The annual report on trade in Chilean nitrate by Messrs. Aikman (London), Ltd. states that in consequence of the agreement between the holders of large stocks and the Nitrate Producers' Association (cf. J., 1921, 396R), existing stocks will probably be cleared by the end of June, after which, if not before, the Association will resume selling. Stocks in Chile probably amounted to about 1,411,000 tons on December 31, much of which cost about 8s. to 9s. 6d. per quintal (quintal=101·6 lb.) to produce, and a reduction in price is considered improvable until these stocks have been liquidated. Production costs have now fallen to 6s. to 7s. 6d. per quintal, and a further reduction by about 6d. to 1s. per quintal is anticipated owing to the introduction of improved methods of extraction. Production, however, stands at about 30 per cent. of the normal and only 34 *officinas* are operating, mostly at half capacity. In Chile it is thought that the action of the Association's sales committee in raising prices to an unduly high level early last year is responsible to some extent for the present situation, and when the term of the Association lapses in 1924 there may be opposition to its renewal in the present form. The actual method of fixing prices in Chile is thought to discourage small dealers from making forward purchases, and it is suggested that the best interests of the trade would be served by allowing each producer to sell freely and by restricting production to market requirements.

During the past year the economic crisis and, to a certain extent, the drought, seriously affected the consumption of fertilisers, and prices fell heavily, quotations for nitrate of soda declining from 18s. 6d. to about 13s. per cwt., and for ammonium sulphate to 15s. per cwt. in the United Kingdom; German nitrogen products, owing to the depreciated mark, cost about 7s. per cwt. In the coming season it is thought that the high price and short supply of ammonium sulphate will prevent it from competing to the same extent as in the last season.

COMPANY NEWS.

ALBY UNITED CARBIDE FACTORIES, LTD.—The extra-ordinary meeting held on December 22 to consider a winding-up resolution (*cf.* J., 1921, 477 r) was adjourned to a date not later than February 28 next with a view to finding some means of rendering liquidation unnecessary, prominent officials of the Norwegian Government having expressed a strong hope that such a drastic step might be averted.

LOW TEMPERATURE CARBONISATION, LTD.—Sir H. Gould-Adams announced to the meeting, held on December 29, that the plant at Barnsley had been running continuously since August without a mishap; that about 2000 tons of coal slack had been converted into smokeless fuel; and that well over 30,000 gallons of tar-oil had been produced and sold at a profit. Strictly speaking, the plant was an experimental one, but the directors claimed that what twenty retorts would do, and have done, any number of retorts would accomplish, and show large profits. Many eminent engineers were convinced that the plant would be a commercial success. Mr. H. Hamilton, of Close Brothers and Co., stated that the low-temperature tar produced was being analysed by the very best chemists, and that the reports received so far had been most satisfactory.

SOCIÉTÉ INDUSTRIELLE DU RADIUM.—At the ninth ordinary general meeting, held in London on December 21, the chairman said that much valuable ore had been raised at the South Terras Mine in Cornwall, and the ore now in stock was estimated to contain approximately 5000 mgrm. of radium. There was no market for the ore in Great Britain, as there was apparently only one British firm manufacturing radium, and owing to the adverse rates of exchange, France and Germany were only buying small amounts. The directors had decided to erect at the mine a plant for producing barium-radium sulphate, for which purpose debentures for £15,000 would be issued; the plant, it was hoped, would be working by the end of March, 1922. Quite recently a valuable patch of ore had been struck, and there was a considerable quantity of ore in sight yielding 80–100 mgrm. per ton.

BROKEN HILL PROPRIETARY CO., LTD.—Operations at the company's iron and steel works at Newcastle, N.S.W., are to be reduced to 30 per cent. of the normal; of the three blast-furnaces which have been working for some time, only one will remain in blast. This action has been rendered necessary by the very severe competition of European steel-producers, who on account of low producing costs can sell their products in Australia at lower prices than they can be manufactured in the Commonwealth, in spite of existing tariff measures. The cost of manufacturing coke at the company's by-product plant is about 34s. per ton, as against 25s. per ton for coke in England delivered at works; blast-furnace labourers receive 15s. 1d. per day, and labourers in steel-works 82s. per week, compared with 7s. 10d. and 50s., respectively, in England.

MINERALS SEPARATION, LTD.—At the 16th annual meeting, held in London on December 23, the chairman, Mr. F. L. Gibbs, said that several of the company's plants for recovering fine coal (*cf.* J., 1921, 44 r) were being erected for industrial use, and one would be ready to start in a few weeks' time. Innumerable experimental tests had shown the efficiency and versatility of the process. An interesting and very important application of the process was to the conversion of a semi-coking coal into a coking coal by separating the coking portion from the non-coking, the latter being made available for combustion. By applying the company's methods to the manufacture of metallurgical coke,

it had been proved that the crushing strength of the coke thus cleaned was very much greater than in the case of ordinary coke. The Powell Duffryn Steam Coal Co. was preparing plans for a plant to treat the whole of its coke requirements, and that would mean a larger plant than that now being erected by the Skinningrove Iron Co., Ltd.

Experimental trials of a new method of briquetting were giving good results; the method obviated the necessity for drying the coal and dispensed with much of the usual machinery. If the trials at Powell Duffryn ended satisfactorily, a long-term agreement would be made with that company for the manufacture of briquettes on a large scale. The activities of the company were now practically world-wide; there were prospects of successfully applying the company's methods to the extraction of nitrate from "caliche"; and a large interest had been acquired in a new ore-reduction process, which had proved successful in every experimental trial and a plant for which had lately been erected.

SULPHIDE CORPORATION, LTD.—Reviewing the position of the mining companies at Broken Hill at the annual meeting held on December 22, the Right Hon. the Earl of Kintore referred to the disastrous effects of the award of Mr. Justice Edmunds in September, 1920, which was accepted by both parties to the long industrial dispute. By that award wages were fixed at a high rate and working hours were reduced, irrespective of the selling value of the output. Owing to the great fall in the prices of lead and silver the poorer and smaller mines could not resume work, and the better-placed mines could work only with a very small margin of profit, which would disappear if the prices of lead and silver declined further. Before the war the Corporation produced about 200,000 tons per annum of crude ore; since 1915 every year had been marked by a strike, and in the five months July–November, 1921, the output has been only 62,419 t. Costs had risen continuously with reduced production, and at present the cost of producing a ton of lead concentrates from ore was about £15 17s., compared with £6 19s. a ton in 1916. Fortunately, the Corporation was able to reduce expenditure by utilising its large accumulation of slimes, of which 175,000 t. was still left, one ton of slimes being put through the mill with five tons of ore. Further progress had been made in separating lead and silver from zinc concentrates.

The manufacture of sulphuric acid and superphosphates at Cockle Creek had proceeded continuously and the outputs for the year of 21,737 t. of acid and 26,991 t. of superphosphates were the largest yet obtained. The acid works had been extended and when completed the capacity would be about 40,000 t. of chamber acid. There was a fair margin of profit on these manufactures and without this the company's working account would have shown a substantial loss instead of a small gain.

The English zinc works at Seaton Carew had had an extraordinarily bad year owing to dear coal and other materials, high wages, and the high cost of zinc ores and concentrates. In consequence all the zinc works in England had closed down, but an arrangement, to last for 6 months, had recently been concluded with the Board of Trade for the supply of Australian zinc concentrates, as a result of which all the English zinc works would shortly resume operations. The net profit for the year ended June 30, 1921, was £30,009 and the financial position was strong, but production of ore at Broken Hill must continue to be small until the Edmunds Award was modified. The output for the current year would probably be about 120,000 t. of ore, with which 21,000 t. of slimes would be worked, and the profit would depend upon the prices of lead and silver, the income from the sale of zinc concentrates to the British Government being independent of the price of spelter.

REVIEWS.

A TEXT-BOOK OF INORGANIC CHEMISTRY FOR UNIVERSITY STUDENTS. By J. R. PARTINGTON. Pp. iv. +1062. (London: Macmillan and Co., Ltd. 1921.) Price 25s. net.

It may appear that we have already too many text-books of Inorganic Chemistry, but those of us who teach know how insufficient many of them are; there is always room for a new exposition of the basic facts and principles. Prof. Partington has attempted such an exposition, and it should at once be said that, in the opinion of the writer, he has attained a very considerable measure of success.

Apparently, the author set himself the limit of about 1000 pages in which to discover the field of inorganic chemistry to a depth sufficient for the average university student. It may well be argued that this space is insufficient to contain the matter which should be presented to the student for a Pass or Honours degree in chemistry, but within this limitation the book is admirably well done—so well indeed that criticism, which is the function of a review, proved extraordinarily difficult on a mere reading of the work. The book was, therefore, taken into regular use for some weeks in general teaching; and the practical test thus made of its substance and method prove that both are excellent.

There has been in recent years rather a tendency to allow discussion of theoretical matters to crowd out facts from chemical text-books, thus neglecting the obvious truth that the facts of chemistry—"descriptive chemistry," if one prefers that term—constitute the real substance, whereas the framework of theory we have constructed to aid our limited minds is but the shadow. It is an important characteristic of Prof. Partington's book that it is a very sound, old-fashioned and up-to-date presentation of descriptive chemistry, illuminated but not overshadowed, by the theories we use. Moreover, these are not the mere dry bones of chemistry, for at every turn the facts and theories are endowed with human interest by brief but sound accounts of their history, whether old or recent, or by explanation of their industrial significance. Many things of interest in the newer facts of chemistry, *e.g.*, the methods of determining the electronic charge and the essential data concerning isotopic elements, are briefly, but adequately, introduced.

The mechanical details of the book are good: it is well printed on good paper, judicious use of various types facilitates reference, and the book as a whole is singularly free from misprints and those minor errors which are the normal sport of the reviewer. The index is better than most.

In short, Prof. Partington's work is so good, when judged by comparison with the average of like books that even constructive criticisms, such as the writer now proposes to offer, require to be justified by the consideration that there is nothing so good that it might not be better.

The treatment of the metals is a little unequal and as a whole, in the reviewer's opinion, unduly subordinated to that of the non-metals. Practical chemistry, including that performed by the average university student, is very largely concerned with the metals and their compounds. One hopes that some day a text-book may be written in which the development of chemistry will be begun (as, in fact, it did begin) with the chemistry of the metals, the non-metals being relegated to the tail-end of the book. It would be a most interesting and instructive experiment.

Prof. Partington adopts the conventional plan (and it is only a convention), and disposes of the metals in his last 250 pages. As a result, the book does not, in the writer's opinion, contain enough of the chemistry of the metals to satisfy the require-

ments of the advanced student. There is, indeed, no one book which meets this need, and it would be well worth while, in a future edition, to add, say, 200–300 pages on the metals and so make their treatment adequate and the book as a whole unique among text-books of chemistry.

There are no references to the literature: for the class of students for whom the book is intended these are desirable upon important matters such as Morley's work upon the composition of water, Landolt's experiments upon the conservation of mass, etc., even when, as in these cases, the brief account given is excellent.

The preface refers to the care bestowed upon the statement of physical properties, and there is, in fact, an unusually large mass of accurate data in the book. A good deal of this matter might perhaps with advantage be tabulated at one end of a future edition.

The reasons advanced for the adoption of $H=1$ as the standard of atomic weight seem altogether insufficient: they cannot alter or evade the fact that the actual standards, for there are really several, are oxygen, chlorine, silver, etc., but *not* hydrogen. In such matters the universal practice of chemists should be made the basis of teaching, however inconvenient it may be from the teacher's point of view. In another defiance of convention, the use of the name "beryllium" (though here, be it noted, the accepted practice is not universal), Prof. Partington has the entire sympathy of the reviewer, who has no sort of use for such a sticky and unsatisfying word as "glucinum."

Reviewing the whole matter, it is clear, that whilst this text-book may yet be improved (and what may not?), it should be heartily commended both to teachers and students in university classes, and its author should be accorded our thanks for a difficult task well done.

II. V. A. BRISCOE.

ORGANIC COMPOUNDS OF MERCURY. By F. C. WHITMORE. *Monograph Series of the American Chemical Society*. Pp. 397. (New York: The Chemical Catalog Co., Inc. 1921.) Price \$4.50 net.

This volume forms one of a series of monographs which is being published by the American Chemical Society with the two distinct objects of affording readable accounts of various subjects for the general chemist and critical surveys with full references to the literature for research workers in the field.

The present volume succeeds more particularly in respect of the second object, and necessarily so, for the organic compounds of mercury have few points of interest for the general chemist. They are easily formed in various ways, many aromatic and heterocyclic compounds yielding mercury derivatives when boiled with aqueous mercuric acetate, and here the fact that nitro- or carboxy-substituents in the benzene nucleus direct the acetoxymercuri-group into the *ortho*-position is of special interest.

A few organic compounds of mercury have found a limited application in medicine, whilst others have served as intermediate products in the preparation of aromatic derivatives of phosphorus and arsenic. Apart from these examples and the probable formation of such compounds in reactions where mercury acts as a catalyst, as in the hydration of acetylene, there remains little of any wide interest.

For those who desire detailed knowledge of the field, however, this book will prove to be of great value. It consists essentially of two parts, following a brief (13 pp.) historical outline. The first part (Chapters II. and III., 72 pp.) summarises the general methods of preparation and reactions of these compounds. Six general methods of preparation are given and the types of compounds which may be obtained by each method are clearly set

forth, whilst eleven general reactions (with acids, bases, and so on) are discussed. The second and largest portion of the book (Chapters IV. to XIV., 270 pp.) describes the individual organic compounds of mercury in sumptuous detail. In many cases the sub-headings, preparation, properties (physical), and reactions, are employed, any number of methods of preparation or reactions up to a dozen or so being recorded with full references to the literature. The published analyses of the compounds have been examined critically and satisfactory estimations of the constituent elements are indicated by the appropriate symbols given in brackets in the course of the descriptions of the substances. Appendices include an article on the analysis of organic mercury compounds embodying, as frequently throughout the book, the results of the author's own experience, a list of proprietary mercurials, bibliographies, and a list of patents on the subject.

The book is well printed and has been edited with care. It affords a very complete record of the organic compounds of mercury, and cannot fail to be of the greatest value to those who require detailed information, either about the general methods of preparation and properties of these compounds, or about individual substances.

FRANK LEE PYMAN.

THE CHEMISTS' YEAR BOOK. By F. W. ATACK and L. WHINYATES. *Sixth edition, in two volumes. Pp. viii.+1142. (Manchester: Sherratt and Hughes. 1921.) Price 21s. net.*

In an earlier review of this book (*cf.* J., 1919, 320 R), although due credit was given to its considerable merits, attention was directed to certain sections which were much in need of improvement. It is satisfactory to note that these criticisms have been taken to heart, and that the present edition is a marked advance on its predecessor. The physico-chemical sections in particular bear evidence that they have been revised by persons competent in the subject. The chief improvements in the present edition are the revision of the section on "Fuels and Illuminants" by H. Moore, that on "Crystallography" by Dr. E. H. Rodd, and the section on "Cellulose" by C. F. Cross. The "Coal Tar" section has been completely rewritten by W. H. Coleman.

The "Year Book" contains a mass of useful information in brief compass, and the editors are to be congratulated on its steadily increasing value as a work of reference.

GEORGE SENTER.

AGGREGATION AND FLOW OF SOLIDS. By SIR G. BEILBY. Pp. xv. + 256. (London: Macmillan and Co., Ltd. 1921.) Price 20s. net.

The study of the properties of solids, especially as modified by the application of forces producing mechanical deformation, was very greatly advanced by the suggestion, made by Sir George Beilby in 1903, that the flow of solids took place through the formation of a vitreous modification possessing temporary mobility. This hypothesis was arrived at as the result of experiments on polishing metals, minerals, and glass, and by the examination of the behaviour of thin metallic films. It was found to be of great service in explaining the effect of cold-working on metals and in giving a rational explanation of the puzzling phenomena of fatigue. The new hypothesis was, after some controversy, accepted by most metallurgists in this country and in America, but has never yet met with wide acceptance on the Continent. One reason for this is that Sir George Beilby's papers were published in several different journals, some of which were not readily accessible, and another was to be found in the modifications and extensions of the original hypothesis, due to

other workers, especially to Dr. Rosenbain, which were not easily disentangled by foreign readers. Reference to current German text-books will show that these interesting researches are usually quoted at second-hand, and that their bearing is by no means fully understood. The publication of the present handsome volume makes it possible to follow the course of the fascinating investigations which have been conducted by Sir George Beilby during more than twenty years, and to trace out the sequence of his discoveries. The book does not consist of a reprint of the original papers, but it contains their matter, rearranged and co-ordinated, with additional evidence and illustrations, some interesting matter hitherto unpublished being included. It makes no pretence to be a critical review of the subject, and the work of other investigators is not usually considered, but the monograph represents a personal record of original work, performed with the simplest of experimental equipment, and exhibiting throughout an originality and freshness of treatment which make it a model of research as well as an important contribution to molecular physics and to metallurgy.

C. H. DESCH.

PUBLICATIONS RECEIVED.

BLEACHING AND RELATED PROCESSES AS APPLIED TO TEXTILE FIBRES AND OTHER MATERIALS. By DR. J. M. MATTHEWS. Pp. 676. (New York: Chemical Catalog Co., Inc. 1921.) Price \$8.00.

AN INTRODUCTION TO THE PHYSICS AND CHEMISTRY OF COLLOIDS. By E. HATSCHEK. *Fourth edition, entirely rewritten and enlarged.* Pp. 172. (London: J. and A. Churchill. 1922.) Price 7s. 6d.

MATIÈRES COLORANTES ARTIFICIELLES: LEUR FABRICATION ET LEUR EMPLOI. By the late PROF. H. VASSART. *Preface by J. GARCON.* Pp. 233. (Paris: Albin Michel. 1921.) Price, paper, 30 fr.

A COURSE OF PRACTICAL ORGANIC CHEMISTRY. By DR. T. SLATER PRICE and DR. D. F. TWISS. *Third edition.* Pp. 239. (London: Longmans, Green and Co. 1922.) Price 6s. 6d.

THE MICROSCOPE. By CONRAD BECK. Pp. 144. (London: R. and J. Beck, Ltd. 1921.) Price 2s. 6d.

FIRST REPORT OF THE GAS CYLINDERS RESEARCH COMMITTEE. *Department of Scientific and Industrial Research.* Pp. 126. (London: H.M. Stationery Office. 1921.) Price 7s. 6d.

FUEL FOR MOTOR TRANSPORT. *Second Memorandum by the Fuel Research Board. Department of Scientific and Industrial Research.* Pp. 16. (London: H.M. Stationery Office. 1921.) Price 6d.

INTERIM REPORT OF THE DOMINION CHEMIST FOR THE YEAR ENDED MARCH 31, 1921. Pp. 67. (Canadian Department of Agriculture. Division of Chemistry. Ottawa. 1921.)

JOURNAL OF INDIAN INDUSTRIES AND LABOUR. Vol. I. Part 4. November, 1921. Pp. 411-568. (Calcutta: Superintendent Government Printing. 1921.) Price Rs. 1-8.

BULLETINS OF INDIAN INDUSTRIES AND LABOUR. (Calcutta: Superintendent Government Printing, India. 1921.):—

THE GENOA LABOUR CONFERENCE. No. 17. Price 1 rupee.

PROCEEDINGS OF THE THIRD CONFERENCE OF THE DEPARTMENTS OF INDUSTRIES. No. 18. Price 1 rupee 4 annas.

THE PERFUMERY RECORD YEAR-BOOK AND DIARY FOR 1922. (London: G. Street and Co., Ltd.)

ECONOMIC MINERALOGY.

J. ALLEN HOWE.

Sixty or seventy years ago geology and mineralogy were still in a state of "purity," but the useful application of these "pure" sciences was beginning to be appreciated, and about that time there was established in this country a "Museum of Economic Geology." Fashion, however, rules in the world of science as in other worlds, and later, in compliance with her edict, the title of that institution was changed by putting "Practical" in place of "Economic." Once more we have reverted to "Economic" Geology, which means no more than the established principles and hypotheses of geology applied to the service of mankind: there is still one geology not two geologies, one mineralogy not two mineralogies.

In a recent number of this journal Prof. J. B. Farmer gave a most interesting and informative account of the present position and future possibilities of Economic Botany (*cf. J.*, 1920, 157 n). It may contribute to an understanding of the status of the Economic Mineralogy if a comparison is made between the respective fields of action of these two branches of applied natural science. Although both are concerned with the employment of materials that are essential to modern civilisation, there is a great difference between the range of the one and of the other.

The economic botanist (and it is equally true of the zoologist) is dealing with vital activities, and within limits it is in his power to create or inhibit development in his material, to stimulate growth in pre-ordained directions, to transplant and conserve it, and there are no visible bounds to his power over this plastic medium. With the economic mineralogist—or geologist, as I prefer to call him, for the greater includes the less—it is very different; he can neither create new varieties of his material, nor interfere with its development; he can translate, but he cannot transplant, and he can only conserve his material in a passive manner by leaving it alone. Briefly, the economic geologist is concerned with the finding of minerals—using the term with the widest possible connotation—and that is all. But it is the starting point of a long chain of industrial activities employing the miner, the metallurgist, the chemist and the manufacturer, the transporter and the merchant.

Economic mineralogy is not a new thing: the art of finding minerals was certainly cultivated at least 6000 years ago; but in its modern phase it is a science as well as an art. The present-day economic mineralogist is a natural product of the growth of specialisation. At one time his functions were regularly performed by the mining engineer, and there are still many members of that profession who are leading exponents of this branch of knowledge; but the great complexity of mining and the multifarious duties of the mining engineer conduce more and more to the practice of calling in specialists on the geological side to assist in the work of prospecting and to advise as mining proceeds.

The result is that not only has economic geology become a separate profession but within the profession itself differentiation and specialisation are taking place. Some make a special study of the occurrence of oil or oil-shales, others concentrate on water supply, iron, gold, copper, non-ferrous metals, and so on.

The stock-in-trade of the properly equipped economic geologist is, firstly, a good grounding in general science; secondly, a sound and extensive knowledge of geology in all its branches, including mineralogy.

The old-style prospector, often a very ignorant man, but possessed by a perpetual *Wanderlust*, the

gambling instinct, and not infrequently a wonderful "eye for country," sufficed for our needs while the variety of minerals in demand was small. The Romans, with no geology, chemistry or mineralogy, as we understand these things, had a remarkable *flair* for picking up the iron, lead, gold, and various other mineral substances wherever they were in occupation. But to-day, when many of the more obvious deposits have been exploited, and ores of increasingly lower values have to be utilised, the principles of geology have to be rigidly applied and the laws governing mineral occurrences and relationships have to be put to the test under more exacting conditions. The modern prospector must be able to visualise complex structures in three dimensions from the evidence of their traces on the earth's surface; he should be able to diagnose all kinds of rocks by up-to-date petrographical methods, embracing optical and micro-chemical tests; he should be able to determine the relative age of strata by their fossil contents; in addition to this he must maintain the closest possible touch with the progress of the mining, metallurgical, and chemical industries, and must keep his eye on the movements of markets and prices. Evidently it is a whole-time job.

For the economic geologist, research in the realms of pure geology and the associated sciences of mineralogy, petrology, and paleontology must continue to furnish the key by which he will unlock and make available the raw mineral resources of the earth. Once the mineral is located his mission ends and the mineral industry begins. The mining engineer, chemist's engineer, the chemist and metallurgist then take up the work, each with the task of bringing the mineral or its products a stage nearer its final market. In each sphere of activity new problems arise, and must continue to arise, demanding continuous study and research. The amount of research carried on at the mine and the works is enormous, and though it is sometimes treated somewhat lightly, it may be just as scientific as much that passes under the same name when carried on in the quietude of academic precincts, to which it is supplementary and complementary.

Recent events have greatly stimulated general interest in the problems of mineral supply; they have emphasised the need, never so fully appreciated before, of exact knowledge concerning the distribution and potential resources not only of the better known minerals but of many that are relatively obscure and little in the public eye. The great nations have been impelled to take stock of their own resources and to inquire as closely as possible into the resources controlled by their neighbours. For minerals have had, and must continue to have, enormous influence upon political and industrial relationships.

It was not alone the entry of the United States into the war that caused it to take a closer interest in the mineral resources of other countries; it was rather the extraordinary disturbance in the industry and the unusual demands made by the war that led naturally to this result. Since not even the most fortunate country can be entirely self-supporting as regards *all* commercial minerals, it is evident that each must envisage the problem with the world as the unit area of production. Seeing this to be the case, the United States Geological Survey has recently issued a valuable "World Atlas of Commercial Geology," showing the distribution of mineral products, with the express object of informing the manufacturers and merchants of the United States along these lines. In Great Britain there has been established with a similar objective the headquarters of an Imperial Mineral Resources Bureau, which, even while putting its own house in order, is constrained to take cognisance of the larger field, the world.

That the fortuitous distribution of mineral wealth within different political boundaries may have a great effect on the trade and other conditions of a country is borne out by abundant examples. Spain, for instance, with her paucity of coal and abundance of other minerals, is prevented from being a great manufacturing State and is compelled to be an active exporter of raw minerals. The accidents of distribution, in special circumstances, may give rise to considerable changes of a quasi-permanent character in the movements of mineral commodities—the aluminium industry in Germany affords an illustration. Before the war one small works in Baden had an output of 800 metric tons per annum. Normally, Germany imports much of her copper. This being cut off during the war she was driven to find something that would partially replace it, and started seven new aluminium works, with the result that 15,000 metric tons is now produced annually; 5000 tons is exported, and the possible yearly capacity is nearly 100,000 tons.

But normal expansion and development, given the raw materials, may in due course give rise to similar readjustments of producing centres. Attention may be called to the situation of the coal and iron industries in India. Already a great iron and steel industry has been established, and great quantities of high grade ore are available. Coal is plentiful, and the output between 1914 and 1918 rose by nearly 25 per cent.; and though this was an exceptional period with cheap labour and a growing demand, an upward tendency is likely to be maintained.

In the case of copper, Great Britain at the beginning of the nineteenth century was leading as a producer and consumer, but about fifty years ago the United States took the lead. Now, however, according to its own authorities, the ratio of reserves to production is probably less than in any of the other great producing centres, and it will not be likely long to maintain its supremacy.

Great Britain at present leads in the production of oil and by-products from shale, but enormous reserves of oil-shale exist in the United States and other countries, and the comparatively near future will see changes in the centralisation of this industry.

Changing centres of production, combined with other influences, have caused changes in the movements of tin, nickel, and antimony.

The natural distribution of minerals is, however, not the sole factor in fixing the location of mineral industries. The character of the power required for the conversion of raw materials into merchantable products may have a paramount influence in establishing the centres of industry, and this again may be affected by a change in the method of reduction. A change from heat reduction to electrolytic reduction may at any time transfer the manufacturing locus from a coal-power area to a water-power area. In this connexion the position of the spelter industry exhibits very interesting features. Superimposed on the dislocation caused by the war, we find the predominance of the old-established distillation process being strongly challenged by the electrolytic method, whilst in the background there is the more or less tentative electrothermic process. Though each method has its own advantages, it is likely that electrolytic treatment will extend, particularly in view of modern labour tendencies.

The fundamental fact, affecting every country alike, is that its exploited minerals, coal, oil, iron, copper, diamonds, or clay constitute in varying degrees wasting assets. While a community has more of a mineral than is required for its own consumption it can export the balance of its production in exchange for other commodities, but in most cases there is a definite limit to this process.

It is therefore the clear duty of every community to take a comprehensive view of its mineral resources and increase its knowledge of them as completely and rapidly as possible so that some kind of policy may be formed for the present and future conduct of mineral exploitation.

Such policy is best initiated by the industries concerned, and examples are not wanting of its existence in various forms. The price of aluminium before the war was stabilised by agreement between the four great producers then operating; the petroleum, diamond, nickel, and fuller's-earth industries exhibit policies of varying scope and importance. The results of action of this kind are not universally approved, but it is a kind of activity likely to develop rather than diminish. It is, of course, not new. We may recollect the case of the worthy cited by Aristotle who made a corner in iron and a pot of money. Although public indignation drove him from his corner he kept the pot.

Governmental control of minerals has rarely proved satisfactory. The normal duty of governments is to encourage investigation of resources, provide good statistics without making the industry feel that it exists for this purpose, remove obstacles to trade, discourage waste, and keep a watchful eye on the political effects of mineral distribution and movements actual and potential.

As regards the conservation of mineral resources, State action must on the whole be negative or passive. Investigation in the United States showed that there were reserves of chrome ore adequate to supply a war demand for several years, but that country is now conserving its domestic supplies by employing higher grade and cheaper ores from foreign countries. The situation is much the same in the case of manganese. In short, the ordinary laws of commerce are allowed to operate.

The only real means of conserving mineral resources lie in improved methods in the details of mining, dressing, concentration, marketing, and in the profitable disposal of waste and by-products, which imply continued research in the cognate branches of engineering, geology, chemistry, and metallurgy.

A knowledge of the world's available resources is a growing demand. To this end the establishment of detailed geological surveys is of first importance; they provide the sure basis upon which intensive investigations can be conducted by technological specialists. Such surveys can never be efficiently carried out by private means. Most of the older States have such surveys in varying degrees of completion. They result in saving much time and money for their respective communities. But vast areas of the earth's surface remain practically uncharted as regards real geological detail, and it is not until this detailed work has been done that we shall be in a position to extract the maximum value in minerals from the ground. As our knowledge is increased in this way new sources of mineral wealth will be discovered, and for a long time any actual dearth of minerals is not to be feared. Changes there will be in the production centres of one mineral or another from time to time, but the possibility always remains that long before the loss is felt of even the rarer minerals the energy released from the nuclei of atoms may have entirely changed the position.

Meanwhile there is plenty to be done. The economic employment of fuels is a vital necessity. The struggle with the difficulties of low-temperature distillation is not finished, and methods of using coal and lignite by extremely fine powdering and emulsifying are still in their infancy. In the sorting of coals there is still room for progress. Many mineral bodies need further investigation for the perfecting of their extraction and development of their uses. The potash-bearing leucite rocks

and glauconitic sands, the minerals containing beryllium, zirconium, barium, strontium, cadmium, caesium, rubidium, boron, titanium, to mention a few, may be expected to attain a different commercial value as our knowledge of their manipulation and uses increases. The employment of alunite and bentonite are examples of comparatively recent utilisation. Then there are minerals that may be used in special ways on account of their optical or other properties due to crystalline form; tourmaline and quartz found peculiar occupation during the war because of their piezo effects. A very considerable trade is done in special varieties of quite common mineral substances such as sandstones, sands and clays, and much more could be done in localising them and in studying their peculiarities.

Much has been accomplished in improving the conditions of grinding, milling, and in the nice adjustment and handling of slimes, and there have been great advances in methods of extraction by electrolysis and of separation by elutriation and flotation. But every mineral proposition presents its own special problems, and there still remain those problems connected with the design and dimensions of furnaces, the properties of refractories, the handling of slags, fumes and waste gases, with the scientific costing of every stage. Clearly no one in the mineral industry need suffer from boredom, so long as there is sufficient business being done to keep the wolf from the door.

CHEMISTRY IN THE MUSEUM.

A. LUCAS.

The cleaning, restoring, and preserving of objects exhibited in museums is a subject of considerable importance, but one upon which, unfortunately, very little scientific investigation has been made. There is only one book dealing with the subject, viz., a small German work, of which an English translation appeared in 1905; and the report recently issued by the Department of Scientific and Industrial Research is, therefore, very welcome.* Unfortunately, it is only a small pamphlet of twelve pages, but it is hoped that it may be the forerunner of many others.

The investigations described have been carried out by Dr. Alexander Scott on behalf of the British Museum. Some years ago, the present writer visited several of the large museums in England in the hope of obtaining information and help with regard to the methods adopted for cleaning and preserving exhibits. The museum authorities were all most courteous and wishful to help, but in only one instance was there any workroom on the premises, and there very little was being done; in another instance objects were occasionally sent outside for treatment; in a third case the need of any special scientific assistance was denied. In every museum, however, there must be problems of cleaning and preservation that require the help of a chemist. Corrosion is essentially chemical, and unless the treatment is undertaken by a chemist who has made a special study of the subject, it is liable to be unsuccessful and even mischievous. In all large museums there should be a chemist on the staff and a suitably-equipped laboratory.

The report referred to deals with Prints, Enamels, Objects of Silver, Lead, Iron, and Copper,

and also Prehistoric Rock Paintings, and it contains five excellent illustrations showing the condition of various objects before and after treatment. A few details of the methods employed by Dr. Scott may be quoted:—

Prints.—The object of treating prints is usually to arrest and prevent the growth of mildew and moulds, and to restore the print to its original appearance. The use of a mild antiseptic agent such as thymol, aided by gentle heat, is suggested. It is pointed out that many antiseptic agents, for example, mercuric chloride and formalin, are dangerous to delicate colours, the latter being readily oxidised to formic acid. Blackening which has taken place in colours containing lead compounds may be removed by means of hydrogen peroxide, which converts the black lead sulphide into the white sulphate. As it is not safe to apply hydrogen peroxide either in the form of a wash or bath, a special mode of use had to be found, and the method finally adopted was to soak a block of plaster of Paris with the reagent and place this at a short distance from the object to be treated. Hydrogen peroxide may also be used for the removal of the unsightliness caused by fungoid growths, but the action is very slow. To remove oil stains from prints the application of dry colourless pyridine is recommended. The pyridine is applied by means of a brush made of glass fibre, and is afterwards removed by blotting paper.

Enamels.—The trouble with enamels is that owing to differences in the coefficient of expansion between the enamel and the metal base, the former cracks and chips off. In such cases the enamels were treated with Canada balsam, which, being applied in a partial vacuum, was forced into all the small cracks when air was admitted. It was found preferable to leave a thin coating of balsam on the enamel as a protection against deleterious acids and moisture from the atmosphere.

Silver.—This metal is particularly liable to corrosion, the principal agent being the common salt present in the soil in which the object has been buried, and the corrosion is continuous even after the article has been placed in a museum. Silver articles containing copper are especially liable to corrosion, and in such cases the best treatment is with a hot solution of formic acid, which removes the copper, but leaves the silver. Other solutions that have been used with success in particular cases are: (a) ammonium sulphite and ammonia containing cuprous sulphite; (b) ammonia and ammonium formate; and (c) zinc dust moistened with very dilute sulphuric acid.

Lead.—Lead objects which have become corroded should be treated either with caustic soda solution containing alcohol or with a solution of basic lead acetate.

Iron.—Prolonged washing with water, followed by treatment with a solution of caustic soda or carbonate of soda, with a final thorough washing and boiling with distilled water, is recommended. An electric treatment which proved successful is also described.

Copper.—The reagents recommended are: (a) ammonium chloride, either alone or with the addition of stannous chloride and a little hydrochloric acid; (b) an alkaline solution of Rochelle salt; and (c) formic or acetic acid.

Prehistoric Paintings and Rocks.—These were freed from lichen by the use of dilute ammonia.

The Trustees of the British Museum, Dr. Scott, and the Department of Scientific and Industrial Research are all to be heartily congratulated, the first for their action in seeking scientific advice, the second for the valuable work he has done, and the last for making the results of Dr. Scott's work available to others to whom it will be both a stimulus and a help. The pamphlet is strongly recommended to all those who have the care of antique objects or who are interested in the subject.

* The Cleaning and Restoration of Museum Exhibits. Report upon Investigations conducted at the British Museum. Department of Scientific and Industrial Research. Bulletin No. 5. Pp. 12. (London: H. M. Stationery Office, 1921). Price 2s. net.

THE SAFEGUARDING OF INDUSTRIES ACT.

DISCUSSION BY NOTTINGHAM SECTION.

The suggestion made in these columns (*cf.* J., 1921, 469 R) that Sectional Meetings might be held to discuss the meanings of certain debatable terms occurring in the Safeguarding of Industries Act was promptly accepted by the Nottingham Section, which held a meeting for this purpose on January 11.

In his opening remarks, Mr. J. H. Dunford, the Chairman, expressed regret that the important terms in question were not defined while the Act was still a Bill, but that it ought not to be beyond the wit of man to frame the required definitions.

Mr. J. T. Wood referred to the *santonin* case, and expressed the opinion that the definition of the word "chemical" was vague, and that the criterion of a fine chemical was its purity; *gallotannic acid* was not one unless it was purified. On the other hand, if purity were the only criterion, both pure sulphuric acid, largely used as a heavy chemical, and purified common salt were fine chemicals.

Mr. J. Waugh thought that a manufacturer's idea of the meaning of the words "fine" and "heavy" was apt to depend on whether he was a buyer or a seller; if a buyer, he was predisposed to consider the substance "heavy," and if a seller, "fine." For a similar reason the professor would not be inclined to regard as "fine" many of the highly purified substances he required in his work. He considered that natural products such as *caffeine* and *atropine*, which were manufactured and sold in England before the war, should be placed upon the fine chemical list, as the Act was meant to protect existing manufactures; and synthetic fine chemicals, such as *phenacetin*, should be classed similarly, as they were built up and purified with the expenditure of much labour. He thought that the work put into synthesis and purification was sufficient to make a substance a fine chemical. Any substance of importance to the preservation of health and to the successful waging of war should be regarded as a fine chemical and receive protection.

Mr. F. H. Carr agreed with the chairman that it was regrettable that no body of chemists had been approached to define the terms prior to the passage of the Bill. He thought the discussion so far had centred too much upon the merits of the Act, and to that extent was irrelevant; what was required was to discuss the meanings conveyed by the words before the Act existed. Unfortunately, in the first test case under the Act (*santonin*), the case for the Board of Trade was not very clearly set forth in its technical aspects, whilst the appellants' case was skilfully presented; he sympathised with the Referee's difficulty, and thought it quite likely that he—the Referee—might have to retract the decision that *santonin* was not a chemical. In order to help us to think clearly on this subject, the word "chemical" should first be defined in a strictly scientific sense, and the definition then used as a basis in formulating the commercial meaning and the meaning qualified by the addition of the word "fine"; he held to his own scientific definition, viz., that a chemical, or better, a chemical substance was a pure element, or a combination of elements possessing a uniform composition and identity, and not separable into two or more substances without changing its identity. The view that a distinction could be made between a natural and an artificial substance was untenable; according to this, the same substance can be both a chemical and not a chemical; synthetic *camphor* was a chemical, but natural *camphor* was not; but *camphor* was not a perfect example of that logical

fallacy, since the natural and artificial substances differ in optical properties; *adrenalin* was a better one, for the natural and artificial substances in that case were identical in all respects. He hoped the Section would discuss whether a chemical was necessarily produced by a chemical reaction, and if so, did extraction from a natural substance rank as a chemical process? Under the present ruling, practically all alkaloids were liable to be struck off the Board of Trade list. Further, would they consider whether the fact that a substance was used for its chemical reaction should determine its classification as a chemical? If so, it seemed to him that coal, air, kelp, whale oil, and lime were chemicals; and ether, chloroform, sodium glycerophosphate, &c., were not, since it could be argued that none of the latter was used for its chemically reactive properties. The view that a substance became a chemical because it had other reactive properties than chemical ones seemed to him even more ridiculous, for could it be said that any substance whatever had no reactive properties?

Mr. S. J. Pentecost said that the basic idea of the Act, viz., to secure independence of foreign supplies by developing home manufactures, should be kept in mind. Mr. H. Calam thought it was impossible to frame adequate definitions, and that a committee of scientific experts should be appointed to guide the Referee. Mr. B. Collitt agreed with the last speaker, and also pointed out that if great purity were taken as the criterion of a fine chemical, both ordinary lead and oxygen in cylinders would have to be included. Mr. L. Anderson thought definition was possible, but it appeared to him that those who had been trying had shown considerable bias. The word "synthetic" could not be so limited as to connote a substance which had originally only been obtained from natural sources, but which had subsequently been built up in a chemical works. He would regard *gallotannic acid* as a fine chemical because the process of extracting it required far more chemical skill than, say, the manufacture of *Glauber salts*. In the case of some fine chemicals obtained by extraction, *e.g.*, *cocaine*, the substance had to be broken down and then built up again in the process; such substances had to be regarded as fine chemicals, quite apart from the purposes of the Act, and apart from the chemical changes they undergo.

Mr. H. D. Richmond said the speakers ought to consider the subject from the Referee's point of view, i.e., they should determine what they understood by the various terms before the Act existed. Although he would broadly define a chemical as "a substance produced by a chemical process," that is, "one in which a change of composition occurs," he would include in his idea of chemical change a physical change essential to the production of the substance. For example, he would consider separation of a substance from a mixture by fractionation, *e.g.*, benzene from coal tar, as a chemical process, since the physical changes involved were essential to the production of the substance. Chemical processes included the removal of impurities when they, and not the substance itself, were changed whilst being removed; and also operations involving changes in the substance in course of isolation. Certain classes of substances cannot be regarded as chemicals and should be excluded, for example, foodstuffs. Sugar might, of course, be used also as a chemical, but it should not be so regarded if its chief use was as a food. Similarly, structural materials like iron, and textiles, should be excluded when their main use was for construction and clothing, respectively. As diamonds were not used on account of their purity, they, too, should be excluded. The use of a substance ought to be considered as well as the method of preparation. He would, therefore, include in the class "chemicals"

any "substance used in arts and manufactures to modify the material it is used with." In the case of a substance occurring in a natural material, *e.g.*, santonin, extraction was a chemical process, as its form was changed in obtaining it in a pure state; and that also applied to alkaloids. His definition, therefore, was: "A chemical is a substance extracted by a chemical process, not being a foodstuff or prepared for textile or structural uses, and which enters into an action to modify its composition or that of the substance with which it is used."

In the expression "fine chemical," said Mr. Richmond, the word "fine" must be taken to mean "refined, purified, in a state of purity." A fine chemical was "a chemical manufactured in a higher state of purity than that required for ordinary use." In that way sodium carbonate, sulphuric acid, etc. and other common heavy chemicals would be excluded. Drugs were fine chemicals, and so were many substances used in arts or manufactures containing small amounts of deleterious impurities.

Dr. E. B. R. Pridcaux said that definitions were used for convenience in science, with a knowledge that in most cases they could not be made rigid. In order to convert them into rigid and legal definitions, an arbitrary element must be introduced with the concurrence of expert chemists, who should be asked to decide in doubtful cases.

Dr. J. B. Firth urged that the source of a substance had nothing to do with its classification as a chemical, and he hoped the meeting would pass a resolution to that effect. He argued that the difference between natural and artificial production was in the *modus operandi*; also that many substances formerly known only as plant products were now produced in chemical works by processes that copied Nature; why, then, distinguish between them? The distinction between fine and heavy chemicals was more difficult; purity and the nature of the demand were of considerable importance. According to its state of purity, a substance could be either, and a crude chemical, even if rare, could hardly be called fine.

Mr. J. M. Wilkie referred to price-lists published before the passing of the Act as a good guide to classification. Substances such as sodium sulphate, when purified to the pharmaceutical standard, with the rigid exclusion of specific impurities, became fine chemicals.

Mr. Carr supported Dr. Firth's suggestion, and said that although in many respects Mr. Richmond had well expressed the opinion of those present, he (Mr. Carr) differed from him on one point. He objected to the definition of a chemical as a substance produced by a chemical process, and considered the point of view that, *e.g.*, the fractionation of benzene was a chemical process, would lead to great confusion. Further, he took it to be the general opinion of the meeting that a chemical was not necessarily brought into existence by a process of chemical change in the course of its manufacture. He suggested that a committee of the Section should draw up a schedule of excluded materials on the lines suggested by Mr. Richmond. The word "fine" should primarily signify "fineness," but in trade it was also used to indicate scale of manufacture, degree of skilled labour, high value and high purity; it could not be defined in a few words, but something could be done to indicate where the dividing line between "heavy" and "fine" should be drawn. There must, however, always be a neutral line on which a few substances would fall.

Dr. Firth asked the meeting to resolve that a knowledge of the source of a substance was not necessary to determine if it were a "fine" chemical or not, and that the source and method of production were irrelevant. This was agreed to.

It was decided that the officers of the Section should draft a definition embodying the feeling of those present and circulate it among members.

THE AMERICAN CERAMIC SOCIETY.*

ROSS C. PURDY.

The American Ceramic Society was founded and incorporated in February, 1899, to promote the advancement of ceramic art and science by holding meetings to discuss papers and by publishing original work. Research by the individual worker was taken for granted; and at that time there was no need to co-ordinate the efforts of individuals and groups. Free publication of results obtained by individual workers in the employ of firms was unlikely, as it would have involved the disclosure of trade "secrets," by means of which supposedly superior results were obtained. It is especially desirable in the ceramic industry to break away from this system of trade secrets, but in the refractories branch it has always been particularly difficult to effect this reform. For this the consumers are largely responsible, as the manufacturer is expected to protect their interests—real or imaginary.

The American Ceramic Society is not wholly or even largely a chemical society, and ceramics does not consist entirely of applied chemistry, engineering, or economic geology: it is a combination of all of these. The fundamentals of chemistry and physics must be applied if success is to be attained, and the industry offers unsurpassed opportunities to the chemist, and especially the physical chemist; but the problems presented are by no means easy.

The first collegiate course in ceramics in the world was established by Prof. Edward Orton, Jr., in 1894, in Ohio, and similar courses were subsequently instituted at Alfred University (1900), the University of Illinois (1906), Rutgers College, Iowa State College, etc.; the Federal Bureaux have had ceramics divisions for the past 4 to 12 years; and the American Ceramic Society has been in existence for 22 years. All these institutions have collaborated to the fullest extent not only among themselves but with other engineering and scientific societies, and have produced a large body of literature; but despite all this concerted and individual effort, progress has not been as great as could have been desired. The reason for this has not been lack of the effort or intelligence, but the difficulty of the physico-chemical problems involved, such as those of arrested reactions, in which the physical condition of the materials profoundly affects the properties of the product. Synthetic mixtures do not always give the same results as those of Nature's compounding; glasses of identical composition but made from different materials may differ; clays cannot be compared or evaluated for industrial use on the basis of purely chemical data; although diaspor and bauxite are both aluminium hydrates it does not follow that they are of equal value as clay refractories.

As in other industries, there is need for increased specialisation in ceramics; the broad scientific foundations of the industry have been laid but problems of great importance continually present themselves. The American Ceramic Society recognised this need and organised various industrial divisions, such as the Refractories Division. Each such division has its own research committee and establishes contact with its particular branch of industry and with the relevant technical, scientific, and industrial associations. The 1500 members of the Society consist largely of managers, technical workers, superintendents, and foremen, and only relatively few possess academic qualifications. Consumers of refractories are joining the Society in increasing numbers, so that in the Refractories Division scientists, manufacturers and consumers are co-operating in advancing the industry.

* Abstract of a paper read before the American Section, New York, October 21, 1921.

It is reasonable to hope that as a result of such team work it will be possible to explain why—to take a concrete example—one magnesite furnace-bottom or lining fails on the first heat and another beats all previous records. To solve such a problem, knowledge will be required of the materials, the physico-chemical changes they undergo, the physical and chemical properties of the compounds produced in making and using the refractory, the possible eutectics, etc. It is necessary to know the history of each magnesite granule, the effect of varying proportions of grain sizes, and of different methods of bonding the granules. Silica, chrome, aluminous and silicon-carbide refractories present problems which must be solved before the requirements of the consumer can be met. No industrial problem is of greater importance than that of the right use of refractories: its solution requires the combined efforts of “ceramist,” producer, and user. The efficient “ceramist” must be a petrographer, a physical chemist versed in high-temperature reactions, and an engineer.

WORKING HOURS IN THE GERMAN CHEMICAL INDUSTRY IN 1913 AND 1921.*

The working hours have varied during the last three years in the individual factories of the Rhine-land chemical industry. As a rule before the war the working day at the Bayer Farbwerke was 9 hours (from 7.30 a.m. to 6 p.m. with a midday break from 12 to 1.30), but most of the other factories worked 10 hours. The working time was specially shortened on heavy manual labour. Thus stokers and men making inorganic acids worked an 8-hr. day, and three shifts were employed, which were changed by introducing a 16-hr. shift.

At Höchst, in 1913, the 10-hr. day was the rule, viz., from 6 a.m. to 12 and from 1 p.m. to 5 p.m. Continuous work was carried on in 12-hr. shifts, changed through a weekly shift of 18 hours. The 8- and 9-hr. day was not worked.

At the works of the Aktiengesellschaft für Anilinfabrikation, Berlin, there were different working hours according to the individual work performed and the method employed in the different factories; the 8½-hr. day, 12-hr. day, with the corresponding rest (Berlin-Treptow), and the 10-hr. day in the Filmfabrik Wolfen (6 a.m. to 6 p.m. with a 2-hr. rest), although here there was a special working day of 8½ hours for women from 8 a.m. to 6 p.m. with a rest of 1½ hours, and in the Rummelsburg Works 11 or 13 hours were worked.

The conditions in the Badische Anilin- und Sodafabrik, Ludwigshafen, most nearly resembled those in the Bayer Farbwerke in Leverkusen. The 9-hr. day (from 7.30 a.m. to 12 and from 1.30 p.m. to 6 p.m.) was the basis, although 10 hours were paid for. This practice was also broken in these works in many instances according to the nature of the work; in some cases the men worked through the midday rest period, or, where the work was continuous, in 12-hr. shifts from 6 a.m. to 6 p.m., the 12-hours' work being paid for as 13 hours.

The consideration which chiefly influenced the masters against the 8-hr. day before the war was that of ability to compete with the foreigner. They argued, “So long as we alone introduce the 8-hr. day, and no international agreement on these lines is arrived at, we shall not be able to compete in the

world's markets.” The argument of the protagonists of the 8-hr. day, viz., that the shortening of the hours of labour induced greater output, was not admitted.

The 8-hr. day was introduced into the German chemical industry after the Revolution in November, 1918. The Council of the “Volksbeauftragten” (peoples' delegates) regarded it as one of its first duties to grant the worker, as soon as possible, the 8-hr. day promised for so many decades. The German *Reichsanzeiger* of November 27, 1918, published the following Order, dated November 23, 1918, regulating the working hours of industrial workers:—

“The working time, including rest periods, shall be 8 hours. By agreement, the working hours may be shortened on Saturday, the time lost being spread over the other days. Where work is continuous all male workers over 16 years may be called upon once in every three weeks to work a period of 16 hours, inclusive of meal times, to enable the weekly changes of shift to be made. Female workers over 16 years may be employed, where two or more shifts are worked, up till 10 p.m., provided they are then allowed a rest period of at least 16 hours. In these cases a midday rest of half-an-hour, instead of an hour, may be instituted, but this must be reckoned on the duration of the working time. These rules are not applicable to occasional work, which, in cases of necessity, must be taken in hand on the spot. The beginning and end of the working time and corresponding breaks, except where these are regulated by a contract, are to be fixed by the employer, in agreement with the workmen's delegates and workmen, to correspond with the above rules.”

The chemical industry agreed to these rules forthwith; the 8-hr. day was even introduced in some works before the Order was issued. To-day the 8-hr. day is worked everywhere, with a half-hour break from 12 to 12.30 p.m. Where shifts are worked, they commence at 5.55 a.m., 1.55 p.m., and 9.55 p.m., and end at 2.5 p.m., 10.5 p.m., and 6.5 a.m., respectively. The chief shifts are the first and second, and in the third shift only such work is carried on as is necessary for the maintenance of the business.

SOCIETY OF CHEMICAL INDUSTRY.

MEETING OF COUNCIL.

The January meeting was held on the 13th instant, with the Hon. Treasurer, Mr. E. V. Evans, in the chair.

A letter was read from Mr. T. H. Wardleworth, of Montreal, expressing satisfaction that the Council had treated so sympathetically the question of instituting a general council for the Canadian Sections. It was announced that Prof. H. E. Armstrong had accepted the invitation to deliver the first Messel Memorial Lecture, and that he had chosen as the subject of his discourse, “Rhapsodies culled from the Thionic Epos, including a Discussion of the Conditions Determinative of Chemical Interchange.”

On the report of the Publications Committee, it was agreed to proceed with the printing of the next volume of the Society's Annual Reports (Vol. VI.), that the price to members should be 7s. 6d., and to non-members 12s. 6d., post free, and that a specimen copy should be sent to each of the Local Sections, together with a supply of order forms. Mr. J. Arthur Reavell reported on behalf of the Chemical Engineering Group that it was proposed to form a committee in the United States to look

* From a Report of Geheimrat C. Dulsberg on the Labour Supply of the Chemical Industry of Germany, 1921.

after the interests of the American members of the Group, and that these members would pay the annual fee of £1 ls., a portion of which would be remitted to the committee to cover local expenses. The proposal was approved.

Thirty-nine applications for membership were passed, of which 21 were from the United Kingdom, 6 from the United States, 5 from the Dominions Overseas, and 7 from other countries.

NEWS FROM THE SECTIONS.

MANCHESTER.

On January 6 a meeting was held conjointly with the Manchester Literary and Philosophical Society and the local sections of the Institute of Chemistry and the Society of Dyers and Colourists. Dr. Ardern presided over an unusually large audience (about 230), which was attracted by the announcement of an address on "Biochemical Method" by Prof. Arthur Harden, of the Lister Institute of Preventive Medicine.

After referring to the great part played by the methods used in organic chemistry in the investigation of materials of plant and animal origin, the lecturer discussed some of the difficulties of biochemical research, with special reference to enzymes and vitamins. A great handicap was the inability to control or eliminate all the factors taking part in a change except that which was under investigation, *e.g.*, a change in the concentration of enzymes was always accompanied by changes in the concentration of other substances present, and there was no exact means of knowing to what the resultant effect was due. Such a difficulty was even more pronounced in the study of vitamins, as experiments had to be performed on the living animal which involved, *inter alia*, the provision of subjects of like breed, sex, or proportion of sexes. In depriving an animal of one particular constituent of its diet, some of the earlier investigators had either taken away or left in more than they had intended. The methods and results of recent researches on vitamins were then outlined and discussed.

YORKSHIRE.

At a meeting held in Leeds on January 16, Mr. S. H. Davies in the chair, Mr. N. M. Comber read a paper on "The Characterisation of Clay."

The author, in introducing the subject, pointed out the difficulty in defining a clay, showing that no definition founded on chemical composition or size of particle was of general application. The chief features of these plastic materials, when studied from the standpoint of the soil chemist, are their abnormal physical behaviour as compared with an ideal assemblage of fine particles, such as fine sand. With the latter the permeability varies inversely as the viscosity, whereas with clays no such relation holds, the permeability being abnormally low. Again, the evaporation from a clay is very much less than normal, and the depression of the freezing-point of wet clay with increase of concentration is much greater than normal.

Mr. Comber showed that all these abnormal features could be explained if clay were considered to be composed of very fine particles, each of which was surrounded by a gelatinous or emulsoid surface. This gelatinous layer would tend to fill up the interstices between the particles and so retard permeation; it would also hold water and so hinder evaporation; and in measuring the depression of the freezing-point the water held by the emulsoid surface would not take part in the dilution, so that the depression would then depend on the concentration of the hydrated particles and not on the concentration of dry clay.

Another abnormality of clay is that it is flocculated by lime, whereas electronegative suspensoids in general are flocculated by acids and deflocculated by alkalis. To explain this, the author postulated that the alkali behaved towards the emulsoid surface of the clay particles in a similar manner to that in which it was known to behave towards other colloids, such as tannin, silicic acid, and humus, namely, to cause a voluminous precipitate. This precipitate entangles the suspensoid cores of the clay particles, causes the suspension to settle out more rapidly, and also increases greatly the volume of the sludge so settled. All soil particles could in general be considered to possess emulsoid coatings, but clays were characterised by the predominance of the emulsoid portion, so that the whole behaved like an emulsoid. The greater the predominance, the "fatter" the clay should be; and experimental evidence was given showing that when clays of known origin were compared by flocculation with alkaline calcium nitrate, the volumes of the precipitates were in direct proportion to the "fateness" of the clay.

LONDON.

At the meeting held on January 16, Mr. E. V. Evans presiding, a paper entitled "Further Experiments with Activated Sludge," by Dr. E. H. Richards and Mr. G. C. Sawyer, was read by Dr. H. T. Calvert in the absence of the authors. The experimental work described is an extension of that already published (*cf.* J., 1920, 177r) and was carried out, by request of the Ministry of Agriculture, to determine: whether a larger proportion of nitrogen was recovered in the activated-sludge process than by the older methods of sewage purification; whether the nitrogen in the sludge was available for use as plant food; and the cause of the high nitrogen content of activated sludge.

In laboratory experiments it was found that the fauna contained in the sludge comprised among other organisms: (1) fungal and algal genera capable of fixing ammonia, (2) nitrifying and denitrifying bacteria, and (3) protozoa. By aerating activated sludge mixed with an ammoniacal solution or with sewage, the whole of the nitrogen present was recovered either as ammonia or nitrate. Prolonged aeration led to loss of nitrogen, the loss being roughly inversely proportional to the amount of sludge present. The nitrogen present in activated sludge in excess of that found in the older type of sludges was derived from the ammonia of the sewage, and no evidence was obtained of the fixation of atmospheric nitrogen. The number of protozoa in wet activated sludge amounted to approximately one million per gram, and the cell contents of these organisms contained a large proportion of the extra nitrogen. The numbers of protozoa and of bacteria present were inversely related, and an increase in bacterial numbers due to removal of the protozoa did not lead to improvement in the purification of sewage.

Large-scale experiments were carried out with domestic sewage at the Harpenden Sewage Works and continued for about nine months. Great variations in the strength of sewage, volume of air, amount of sludge, and time of retention, produced no variation in the nitrogen content of the sludge. Although there was no evidence of atmospheric nitrogen fixation, indications were obtained that ammonia was recovered from the sewage by physical or biological means, or by both acting concurrently. With a large air-supply and less than 25 per cent. of sludge in the tank, the sludge recovered was practically equal to the suspended matter in the sewage, but with a decreased volume of air and an increased volume of sludge, over 50 per cent. of the sewage solids disappeared. Under favourable conditions a loss of about 20 per cent. of nitrogen

occurred, but when conditions were bad the loss might amount to 80 per cent. The proportion of total nitrogen recovered during normal working was 15 per cent., which compares favourably with 10 per cent. and 4 per cent. obtained by the precipitation and septic-tank methods, respectively. Field trials made with the activated sludges obtained, which contained about 90 per cent. of moisture, showed that this material compares favourably with sulphate of ammonia and with farmyard manure for the culture of hay, potatoes, and barley, when the different fertilisers were added in the proportions required to supply equal weights of nitrogen.

LIVERPOOL.

A meeting of this Section was held on January 20 in the Muspratt Lecture Theatre of Liverpool University. Dr. G. C. Clayton was in the chair, and a paper on "The Oxidation of Ammonia" was presented by Messrs. C. S. Imison and W. Russell.

About 15,000 tons per annum of Chilean nitrate is normally consumed in this country in the manufacture of sulphuric acid by the chamber process, and as this process utilises nitrogen oxides directly in the gaseous form, it afforded an obvious opening for the application of the ammonia-oxidation process when our supplies of nitrate were threatened during the war.

Starting with pure 25 per cent. ammonia-liquor, gasification takes place in a coke-packed tower in which a current of air meets a stream of ammonia liquor, steam being introduced at the bottom of the tower. The catalyst consists of four layers of platinum gauze sewn together, giving an area of 24 sq. in. In starting off, an air-ammonia mixture of the correct composition (about 1 vol. ammonia to 9 vols. air) is passed through the gauze, which has been heated by means of a hydrogen jet. The reaction is exothermic, and the temperature of the gauze is maintained as long as the mixture passes. Experiments show that when external heat is applied the efficiency of conversion increases. By means of an interchanger the air-ammonia mixture is pre-heated, passing on its way to the platinum gauze round tubes which convey the hot oxides of nitrogen to the chambers. Without a pre-heater, a four-ply gauze 6 x 4 in. is capable of oxidising ammonia equivalent to 35 cwt. of sodium nitrate per week. Using a pre-heater, the gauze can give the equivalent of 50 cwt. of nitrate per week with a considerably increased efficiency.

Under the conditions obtaining in a heat-interchanger, experiments show that most common metals cause the decomposition of ammonia to a certain extent, so that care is necessary in selecting the material of which the tubes are made. Silica is least active in this respect, but on account of its low conductivity and the difficulty of making the apparatus, this material is not readily adaptable. Enamelled cast-iron has been used successfully and, later still, steel tubes coated with a mixture of barium sulphate and sodium silicate.

Using ammonia in place of nitro for vitriol chambers, a much more regular supply of oxides of nitrogen is obtained as compared with "potting" nitre at intervals. The consumption of "nitre" is not increased, and there is a saving of 30–40 per cent. in the cost of materials. The very slight supervision required for a plant of this type is given, at no extra cost, by the "tower-man" in the course of his rounds.

The above process has now replaced "potting" on all the chamber plants of The United Alkali Company in Widnes and on several elsewhere, and similar oxidation plant has been erected by this firm for making liquid nitric acid. Oxidation- and absorption-space is obtained by the use of earthenware towers down which a flow of weak

nitric acid or water passes counter-current to the gases. Nitric acid of 50–55 per cent. is obtained, and this is concentrated to 90 per cent. by feeding down a denitrating tower together with strong sulphuric acid, which has previously been fed down the final wash-towers of the weak nitric-acid side.

EDINBURGH AND EAST OF SCOTLAND.

An informal meeting was held in Edinburgh on January 17, Dr. H. E. Watt presiding. Mr. C. L. Abernethy demonstrated the Shakespear katharometer and Mr. W. G. Martin the Pusey Jones plastometer. Mr. A. H. Baird exhibited the "Reflex" lantern, the "Micro" lantern, a new form of Bunsen burner, the "Universal" boss-head clamp, and other apparatus, and Messrs. Baird and Tatlock showed a new "Analytical" balance and apparatus for testing oils.

GLASGOW.

Mr. J. H. Young presided over a large audience at the meeting held conjointly with the Local Section of the Institute of Chemistry on January 12 to discuss "The Teaching of Chemistry."

Prof. R. M. Caven, at the outset, drew attention to the fact that there was one, and only one, chemistry, and that such subjects as engineering chemistry and agricultural chemistry did not in reality exist but were simply chemistry applied to engineering and agriculture. The study of chemistry was the study of Nature herself in all her changes of material composition—a study which transcended even that of the applications of chemistry; so that chemistry should have a place in the teaching of the school, not for the sake of chemistry itself but as a contribution to the education of the future citizen. Time spent in the study of historical chemistry would yield much of the fruit of inspiration. Dr. Caven then discussed the training of the chemist from two standpoints:—(a) subject matter, and (b) method. (a) The study of chemistry was the study of the elements and their compounds, but before commencing it the student required a knowledge of physics, mechanics, and mathematics, so that the fundamental principles of the subject might be understood. After acquiring the principles and the associated facts he should learn classification, mainly through the Periodic Diagram—the chemist's "map of the world." (b) The subject should be taught by lecture and practical courses, and of these the practical work was fundamentally the more important. In the lectures facts should come first, and theories to unify them should follow. Practical work should begin by investigating the laws of chemical combination, the determination of equivalents, and lead up to simple exercises in volumetric analysis, with which would be associated studies of types of reaction, solution and colloidal state, etc., and then would come a course of qualitative analysis. By such a scheme of teaching the true chemist would be a man whose mind and hand were actively engaged in the solution of problems presented by the inter-relations and transformation of matter, whether these problems were philosophic or economic.

The chief points brought out in the discussion were:—Chemistry should be taught in schools as a method of training the mind; there should be a closer connexion between academic teachers and those engaged in chemical industry with a view to collaboration; there should be, in a student's course, opportunities for the study of logic, a greater attention paid to the expression of results, and a higher study of mathematics in its applications to chemical reactions; there should also be a systematised course of chemistry in all Scottish schools, in addition to the so-called "science" course.

MEETINGS OF OTHER SOCIETIES.

BIOLOGICAL SOCIETY OF BIRMINGHAM UNIVERSITY.

In his presidential address, entitled "Biology and Chemistry," Prof. A. R. Ling discussed some matters on the border-line between these two sciences. The advantages of closer association between biologists and chemists provided the main theme of the address; the best and most fundamental scientific work, said the lecturer, always resulted from co-operation between two or more departments of science, and the conjoint work of chemist and biologist afforded a striking instance of the truth of this statement.

After a survey of the history of both branches of science, in which it was shown that chemistry had been the "handmaid of physiology" from the earliest recorded times, the inter-relation of chemistry and biology was illustrated by consideration of the mechanism of production of carbohydrates in the living cell, and this subject was used with effect to demonstrate the differences between chemical action in the living organism and some of those carried out in the laboratory. From the standpoint of history it was shown that whereas biology and physiology received attention in Greece in the third century B.C. (and possibly a thousand years earlier in Egypt), chemistry was developed on closely parallel lines in all ages, the practical achievements of the earlier alchemists and the phlogistonists being especially emphasised. It was owing to ignorance of the history of science that we frequently looked back with a kind of contempt to these periods of chemistry, overlooking the value of the positive discoveries of the times because the chief theories of chemistry then current had been overthrown or considerably modified.

The earlier stages of "organic chemistry," as developed in the past century, were marked by a reaction from the old theories that was carried too far, inasmuch as it led ultimately to the belief that any chemical action occurring *in vivo* could be repeated *in vitro*. The chemist had, indeed, established that chemical actions, whether occurring in a flask or in a living organism, were of one kind, absorbing or evolving the same quantity of heat energy, but he failed to recognise the significance of the difference in the conditions under which each occurs. Thus combustion at ordinary temperatures can only be accomplished by the living cell (or by enzymes, which have hitherto only been derived from living organisms) and in the living cell we have to admit the existence of directive agencies, exemplified by the production in nature of asymmetric compounds, whereas laboratory methods lead to the formation of racemic substances.

The assimilation of carbon dioxide by plants under the influence of sunlight and chlorophyll was considered with reference to recent work by Baly and his collaborators (*cf. J.*, 1921, 377 R). Prof. Ling suggested that formaldehyde can never exist as such in the plant, and the simplest product of photosynthesis would instantly combine with protoplasm; the stored energy of the latter would suffice for further polymerisation, first to a hexose, and then, as this product passes on from cell to cell, to a non-reducing carbohydrate—disaccharide, starch or cellulose. He emphasised that except at certain specific times (*e.g.*, the ripening stage of succulent fruits) hexoses are found only in minute amounts: the storage carbohydrates are non-reducing substances, *i.e.*, they do not contain carbonyl-groups which are chemically and physiologically active and so combine with amino-groups in the protoplasm. It was shown that the energy requirements necessary to produce the storage carbohydrates can be satisfactorily accounted for, at all

events, qualitatively, on this hypothesis, and that Horace Brown and Morris's observations that cane-sugar is the first actual sugar to appear in the photosynthetic process is in harmony with the lecturer's suggestion.

It was pointed out that pentoses are formed in the plant by the oxidation of hexoses, and here the incidence of the same factor (the combination between free carbonyl-group and protoplasm) was shown to form the basis of de Chalmot's explanation of the formation in plants by oxidation of *l*-xylose whereas on oxidation in the laboratory *d*-glucose gives rise to *d*-arabinose and *d*-galactose to *d*-lyxose. *In vitro* the reactive carbonyl group is free and is first attacked, but in the plant cell it is at once fixed by constituents of the protoplasm, and consequently the point of attack is the terminal primary alcohol group at the opposite end of the hexose-chain of carbon atoms.

The address concluded with a plea for the direction of more attention to the conditions of chemical action in the living organism, now that the main outlines of chemical processes in the laboratory are relatively well understood. Laboratory syntheses have their own importance and may be of primary significance to a country like Germany, largely dependent upon imported natural products; but to chemists of the British Empire, with its huge potential natural resources, biochemistry is at least of equal value, as Sir W. J. Pope has recently pointed out. The true work of the biochemist is to elucidate the course of chemical change in Nature's laboratory.

THE ROYAL INSTITUTION.

The first Friday Evening Discourse of the present series was delivered on January 20 by Sir James Dewar, who lectured upon "Soap Films and Molecular Forces," a subject to which, as he said, he had been obliged to return owing to the funds of the Institution being at present inadequate for the prosecution of low-temperature research.

Details were given of investigations into the rate of downward propagation of the boundary between the black and coloured regions of a vertical film, due to draining of the film under gravity. In the case of a film supported above and below, the velocity of fall of such boundary was found to be uniform over a considerable time. Experiments carried out to determine the rate of fall of a thin film supported at its boundary by the walls of a vertical tube, indicate that such experiments afford possibly the most accurate means of determining the uniformity or otherwise of the bore of such tubes, the velocity of fall being much altered by any change in cross section of the tube. Incidentally the lecturer referred to the thickened region of a film where contact is made with its support as the Gibb layer or ring, and showed that this layer, independently of any gravitational effect, could effect thinning of the film down to a thickness approaching molecular dimensions, with consequent development of a black area on the film. The existence of the Gibb ring is also responsible for the production of differences in the composition of various regions of the film. Reference was made to the estimates of the thickness of the black area in thin films by Plateau, Reinold and Rücker, Johannott, Rayleigh, Miss Pockels, Perrin, and others. Perrin, by an interferometer-method, had established the existence of 38 varieties of black within the first series of Newton's colours in such films. These he attributed to the superposition in the film of successive layers each about 5 millionths of a mm. thick. The strength of thin soap films was illustrated by the passage through the film of drops of liquid air, the film remaining intact after such passage.

Hitherto the lecturer had not succeeded in shooting drops of liquid air through a black film without rupture of the film. The subject of the strength of thin films was further illustrated by producing in the films vortices due to the impact of jets of air in various directions. The films, gorgeously coloured owing to interference, were projected on the screen, and the characteristics of the various coloured regions and of the vortex motion were briefly referred to.

The following exhibits were included among those shown prior to the lecture: Prof. A. Smithells exhibited models illustrating the Lewis-Langmuir theory of atomic structure; Mr. P. R. Coursey demonstrated the production and transmission of sound waves by means of the piezo-electricity developed by pressure or torsion of crystals of Rochelle salt; among other uses, the device found application in a gramophone reproducer. Experiments illustrative of surface tension effects, simulating vital movements and produced by drops of ortho-toluidine, dimethylaniline and quinoline upon the surface of water were shown by Mr. C. R. Darling. Prof. J. T. Morris exhibited a portable direct-reading electrical anemometer. The exhibits of Messrs. Adam Hilger, Ltd. included a vacuum spectrograph for the Schumann region of the spectrum, and a "strain-viewer" for the detection of strains in glass.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

At a meeting held on January 10 in the rooms of the Royal Society of Arts, Prof. J. S. S. Brame presiding, Dr. W. R. Ormandy read a paper by himself and Mr. E. C. Craven on "An Investigation into the Physico-Chemical Significance of Flash-Point Temperatures."

Preliminary experiments had shown that for a wide range of organic compounds the following relationship holds good: flash-point = boiling-point \times a constant, which approximates to 0.74, the temperature being expressed in degrees absolute. In order to extend the scope of the research a form of apparatus much more convenient than the usual testers was devised, low temperatures being produced and controlled by the evaporation of sulphur dioxide and the ignition by electric sparks. For pure liquids the constant mentioned above was then found to be very close to 0.734. For mixtures such as petrol or kerosene a similar figure is obtained if the "boiling-point" taken is that registered when the first drop falls from the condenser in an Engler distillation test. In such cases, if the amount of the most volatile fraction be very small, it is clear that variation in the liquid/vapour ratio will affect the results. The presence of dissolved permanent gas such as is normally met with in petroleum distillates also introduces a complicating factor.

The relationship holds well for hydrocarbons, but only for the higher alcohols, the lower members showing a steadily increasing divergence with diminishing molecular weight. A few experiments were carried out using oxygen in place of air (when a much lower flash-point was obtained) and under varying pressures. Binary mixtures suitable as motor fuels were investigated, and it was shown that the addition of the more volatile component had a progressively diminishing effect in depressing the flash-point; in certain cases the mixture had a lower flash-point than either of its components.

The paper contains a large number of valuable data concerning flash-points, vapour tensions, and inflammability limits of organic compounds and motor fuels.

The discussion was opened by the president, Prof. Brame, who commented on the somewhat vague re-

lationship between true initial boiling point and "first-drop temperature" in the case of liquid mixtures, and was continued by Dr. R. Lessing, Dr. F. B. Thole and Mr. H. Moore.

THE OPTICAL SOCIETY.

A comprehensive paper on "The Manufacture of Optical Glass" was presented by Dr. C. J. Peddle to the meeting held on January 12. In a brief historical *résumé*, reference was made to Guinand's discovery of the stirring process in 1796, the work of Messrs. Chance Bros. in England about 1848, the experimental work of Harcourt and Stokes from 1834 to 1859, and the later work of Abbe and Schott at Jena from 1836—1914. Optical glass was being manufactured by Messrs. Chance Bros. in England at the outbreak of war in 1914, and owing to the increased demand, research work bearing on its manufacture was commenced at the Derby works of Messrs. Wood Bros. Glass Co., Ltd., in 1916.

The processes involved in the manufacture of a definite type of optical glass, usually specified in terms of its refractive indices for the C, D, F and G' lines of the spectrum, include preliminary experimental work, batch mixing, melting, stirring, cooling, breaking up and examination, moulding and rough annealing, polishing and examination, fine annealing and investigation of optical properties. Remarking upon the corrosive action of molten glass upon the clay of the pot in which the melt was made, the opinion was expressed that when the difficulties arising from this cause were solved, optical glass of a kind hitherto unattainable both as regards quality and price would become available.

Research work undertaken at Derby included extensive investigations of the influence of the composition of the glass upon its density, refractive index, durability, and tendency to devitrification. A detailed account was given in the paper of the dependence of these several qualities upon the composition of the glass in the classes of optical glass typified by the respective formulae $100 \text{ SiO}_2 \cdot 20 \text{ Na}_2\text{O} \cdot x \text{ RO}$ and $100 \text{ SiO}_2 \cdot 20 \text{ K}_2\text{O} \cdot x \text{ RO}$ where R signifies one of the elements calcium, barium, strontium, zinc, magnesium, lead. The results obtained were given in terms of the effect both of molecular addition and of percentage addition of the oxide RO. Among the results obtained the following may be mentioned:—The addition of any of the R-oxides to the nucleus $100 \text{ SiO}_2 \cdot 20 \text{ Na}_2\text{O}$ increases the density. Similarly, molecular additions of any RO type of oxide to the nucleus causes an increase in the refractive index for sodium light (μ_D), and the greater the molecular weight of the RO type of oxide, the higher the value of μ_D except in the case of zinc oxide; in glasses containing the same percentage weight of SiO_2 , Na_2O and RO, the order of refractive index is not that of the molecular weight; both calcium oxide and strontium oxide have a greater effect upon refractive index than lead oxide when they are substituted for sodium oxide in a glass. The durability of optical glass is improved by replacing either some of the silica or of the alkali by RO, the best oxide to use for this purpose being zinc oxide; it is also improved by the presence of both Na_2O and K_2O in the glass. Devitrification is most commonly due to separation of silica and occurs more readily in a glass containing lead oxide than in one containing the same percentage amount of calcium oxide. As a rule when the calcium-oxide content of a glass exceeds 15 per cent., calcium silicate tends to separate out; but when barium and lead oxides are used, the limiting percentages are 25 and 50, respectively.

One hundred different glasses are now being made at Derby. Optical-glass manufacture is prac-

tically research on a manufacturing scale. The yield is considered satisfactory if the quantity of first-quality glass ready for fine-annealing is about 20 per cent. of the original melt; more often than not this yield is not obtained.

THE CHEMICAL SOCIETY.

At the ordinary scientific meeting held on January 19, Sir James Walker announced the names of those who would retire from the Council after the annual meeting, to be held on March 30, as follows:—Vice-presidents: Sir J. J. Dobbie, Sir W. J. Pope, Prof. J. B. Cohen, and Dr. H. J. H. Fenton. Ordinary members of Council: Dr. E. F. Armstrong, Prof. F. E. Francis, Mr. J. A. Gardner, Principal J. C. Irvine, Dr. C. A. Keane, and Sir R. Robertson.

Prof. Arthur Smithells then gave an address on "Models of the Lewis-Langmuir Atom, with Explanations." The announcement of this address caused an immense number of Fellows to come to the meeting, but, unfortunately, owing to the limited accommodation, a large proportion of them could not gain admittance. At the conclusion of the address, which was not suitable for abstracting, the lecturer put forward a possible explanation of the oxidation of carbon monoxide by oxygen. Water is required to catalyse the reaction, as Baker showed, but must be introduced from outside, as that produced within the system is inactive as a catalyst; water so introduced perhaps assumes an enantiomorphic form in contrast with water formed synthetically. Owing to the importance of the subject it is hoped, and anticipated, that Prof. Smithells will write an account for publication.

PERSONALIA.

Prof. Edgar F. Smith, president of the American Chemical Society, has been elected an honorary member of the Société de Chimie Industrielle.

Prof. W. Nernst has been nominated president of the Physikalisch-Technische Reichsanstalt in succession to Prof. E. Warburg, who has retired.

Prof. F. Hayduck, director of the Institute for the Fermentation Industries and Starch Manufacture in Berlin, has been appointed to succeed Prof. Max Delbrück in the chair of technological chemistry in the Agricultural "Hochschule," Berlin.

The following have been elected Fellows of the Institute of Chemistry:—A. Scholes (metallurgy); and C. W. B. Arnold (agricultural chemistry). Eight candidates have passed the examination for the Associateship, four in general chemistry, three in organic chemistry, and one in the chemistry of foods and drugs.

Mr. J. P. Grennan, head of the chemical department at St. Francis College, Loretto, Pa., has become professor of analytical chemistry in Gonzaga University, Spokane, Wash.; and Dr. W. A. Lawrence, associate professor of chemistry at McMaster University, Toronto, has been appointed professor of chemistry in Bates College, Lewiston, Maine.

In the annual report of the Council of the University of Birmingham it is stated that in order permanently to associate the name of Prof. Percy Frankland with the chemical department of the University and to commemorate his eminence as a worker in chemical science, a fund has been subscribed to provide a Frankland Medal and prize of books to be awarded annually to the best student of practical chemistry.

The Senate of the University of London has conferred the degree of Doctor of Science upon Mr. E. B. Maxted.

Prof. B. Rassow, editor of the *Zeitschrift für Angewandte Chemie* since 1903, has resigned and is to be succeeded by Prof. A. Binz.

A tablet containing a medallion portrait of Sir William Ramsay is to be placed in Westminster Abbey; and commemorative medals executed by M. Louis Bottée, will be struck shortly.

The death is announced of Prof. G. Bertoni, formerly professor of chemistry in the Royal Naval Academy at Livorno, Italy.

We hear with regret of the death, on January 16, of Dr. J. F. Bottomley, managing director of the Thermal Syndicate, Ltd., of Wallsend-on-Tyne, aged 46 years.

NEWS AND NOTES.

AUSTRALIA.

Industrial Notes.—*Coal.*—Sir Edgeworth David has examined the Blair Athol coalfields on the Drummond Range, Queensland, and reports that there is an immense seam of black coal with an average thickness of 93 ft., and free from clay bands. He estimates the total contents of the field at 258 million tons.

Irrigation.—Work on the water-conservation dam on the River Murray at Hume, nine miles above Albury, is now in full progress. When complete, the dam, which will be the largest undertaking of its kind in Australia, will enable an immense area on both sides of the river to be irrigated and brought under cultivation.

Petroleum.—The chemist to the Western Australian Government, reporting on samples of asphaltum from East Kimberley, and from a locality near the junction of the Ord and Negri rivers, states that the samples are true asphaltum, left by the natural evaporation and weathering of asphaltic petroleum. Prof. Sir Edgeworth David, of Sydney University, states that the discovery at Kimberley is the first recorded occurrence of true mineral oil in Australia and that, although caution is needed, the prospects from a geological point of view appear distinctly encouraging (*cf. J.*, 1921, 407 R).

The Shale-Oil Industry.—Much interest has been roused by the report of the successful trial at Joadja, New South Wales, by the Oil Shale Products and Coal Co., of an automatic retort for distilling oil from shale at a very low cost. The present output is 700 gallons of crude oil per week, but it is hoped to produce 15,000 galls. per day a year hence and ultimately to sell petrol and kerosene at 2s. and 1s. 6d. per gall., respectively. The shale is fired inside the retort, the original fuel being wood or coal, and the temperature is maintained by adding shale at intervals. The vapour is passed into a condenser, where the light oils rise to the top and are drawn off into a tank in which further separation occurs. This process is continued until a third tank is filled with a mixture of petrol and kerosene, plus a small amount of solids. The gases in the last tank are returned to and burned in the retorts. The oil is refined and tests have shown that the products—petrol, kerosene, paraffin wax, and lubricating oils—are of excellent quality; the output is being taken and used by the South Australian Government and by mining companies. Immense supplies of oil-shale are available in New South Wales and the Joadja deposit, which includes a seam 10 ft. thick, yields from 80 to 100 galls. of oil per ton.

A novel experiment has been made in the Wolgan Valley, N.S.W., where for many years the Commonwealth Oil Corporation has been investigating the mining and treatment of shale on a commercial basis. To avoid using expensive retorts, a large brick chamber was built in the old workings, with provision for controlling the air-supply, and the shale was fired on October 22. Three days later oil was flowing freely, together with large quantities of gas, which it is proposed to use in oil-engines for generating electricity to supply Newcastle, 70 miles distant. It is thought that the whole of the shale, including the inferior material, can be utilised without difficulty in this way.—(*Times Tr. Suppl.*, Dec. 31, 1921.)

The Australian Gas-Light Co., which supplies coal gas to the city of Sydney and possesses 2530 miles of mains, has recently extended its plant in order to meet a rapidly increasing demand for gas for all purposes. In 1910 some 1758 million cb. ft. was delivered, but in the year ended June 30, 1921, this was increased to 4979 million cb. ft. The works at Mortlake on the Parramatta river has an older section where horizontal retorts are used, and a modern and much larger section containing vertical retorts. The No. 4 retort-house contains 160 Glover-West vertical retorts, and two larger houses are in course of construction. The coal is brought in the company's steamers from Newcastle, N.S.W., and is unloaded by an automatic telfer gantry crane, of which an extension is used for feeding the retorts. There is also a carburetted water-gas plant with an output of 6 million cb. ft. per 24 hours.

Much attention has recently been given to the recovery of by-products, and at the present time sulphate of ammonia, benzol, solvent naphtha, and pyridine are being manufactured. Owing to the great demand for tar for road-making much work has been done with a view to making the tar from vertical retorts as acceptable to the road engineers as that from horizontal retorts. By a process of distillation, the crude "vertical" tar is brought into a condition which has proved to be satisfactory for roads, and the whole output of tar has become available for this use. All constructional and repair work is carried out by the company's own staff, the works being self-contained in regard to engineering and constructional equipment.

Mineral Output of New South Wales.—According to the Annual Report of the New South Wales Department of Mines for 1920, the value of the mineral production in that year was £11,411,462, an increase of £1,529,096 compared with 1919. Statistics of output are given below—

		1920			1920
Gold	.. Fine oz.	48,907	Lime, cal-	.. Tons	33,505
Copper	.. Tons	1,290	cined	.. Tons	143,887
Iron, pig	.. "	86,096	Cement	.. "	10,715,999
Iron oxide	.. "	1,574	Coal	.. "	567,569
Shale	.. "	21,004	Coke	.. "	
Limestone	.. "	371,555			

Production of gold declined in 1920 and the State receipts from the silver-lead-zinc mines (comprising silver metal £36,942, pig lead £9905, silver-lead concentrates and ore £76,634, and zinc concentrates £219,456) decreased by £1,522,336 to £372,937, largely owing to industrial troubles at Broken Hill. Production of copper was also smaller, and the output of tin declined in value by £2829 to £413,794.

Since the termination of the contract between the Imperial and Commonwealth Governments the production of molybdenite, wolfram, and scheelite has virtually ceased. The production of coal was the highest on record; the increasing demand for it, both for home consumption and export, will probably stimulate production still further. The output of pig iron produced from Australian ores increased to 5155 tons.—(*Ch. of Comm. J.*, Dec. 16, 1921.)

SOUTH AFRICA.

The Salt Industry.—At the annual meeting of the Salt Manufacturers' Association the condition of this industry was stated to be serious, and it was decided to ask the Government to increase the tariff on salt. Coarse salt is imported at prices that defy competition; the better grades of imported salt are milled into fine salt locally to avoid payment of the 20 per cent. *ad valorem* duty; and the export trade is being lost owing to the refusal of the railway administration to grant a special export rate to ports for shipment. In 1920 the imports consisted of 218.5 tons of common salt (£1050), 385.4 t. of table salt (£12,112) and 156 t. of dairy salt (£1078), nearly all from the United Kingdom; and there were 49 saltworks in the Union, viz., 31 in Cape Province, 8 in the Transvaal, and 10 in the Orange Free State.—(*U.S. Com. Rep.*, Dec. 19, 1921.)

Vanadinite in the Transvaal.—A report by Messrs. M. Fergusson and P. A. Wagner on the vanadinite deposits in the Marico district of the Transvaal is printed in the December issue of the *South African Journal of Industries*. The vanadinite exists in well-formed hexagonal crystals, either alone or aggregated, and occurs in irregular layers, veins or pockets in the manganese earth that constitutes the country rock. In some sections vanadinite is the only ore-mineral present, but it is usually associated with other lead minerals such as pyromorphite, cerussite, and galena, or with pyrites. The total reserves of ore in the workings are estimated conservatively at 4554 tons, with an average content of 2.8 per cent. V_2O_5 . Assuming an extraction of only 80 per cent., this should give 1020 tons of concentrates averaging 10 per cent. V_2O_5 , and in addition a fairly large tonnage of galena. The deposits may be found to extend beyond the boundaries of the present workings, but they will not be extensive. Working is fairly easy in the main (incline) section and as the ore can be concentrated, it should be possible to recover practically all the vanadium at a relatively low cost.

UNITED STATES.

Felspar in 1919 and 1920.—The quantity of felspar sold in 1919 was 63,441 long tons, valued at £347,992, representing decreases of 28 and 13 per cent. in quantity and value, respectively, compared with 1918. In 1920 the demand was very heavy and sales rose by 114 per cent. to 135,551 t., valued at £851,123. Maine and North Carolina were the chief producing States. The Canadian production is sold mainly to the United States; in 1919, 14,679 short tons was sold, and in 1920, 36,856 t.—(*U.S. Geol. Surv.*, Aug. 12, Oct. 29 1921.)

Mineral Potash in Western Texas.—Evidence that potash exists in association with the extensive salt-beds underlying western Texas has been available since 1912, when a brine containing 5.4 per cent. of KCl was discovered at Spur, Dickens County, in a boring 2200 ft. deep. Other borings made since then have shown that a red salt containing 18—19 per cent. of potash, and believed to be polyhalite, is fairly widely distributed. It appears probable that extensive beds of potash exist, but so far there is no evidence concerning their thickness. The information available is, however, sufficiently positive to justify the expense of ascertaining the commercial importance of the occurrences.—(*Chem. & Met. Eng.*, Dec. 28, 1921.)

Power Alcohol from Vegetation.—The General Motors Research Corporation has conducted research on various types of fuels, and some of the results have been expressed in graphs showing change in volatility of motor gasoline from 1915 to date, relations between thermal efficiency and consumption ratio in an internal-combustion engine,

and instructive data on the relation between supply and demand of gasoline, the unmined supply of petroleum as estimated by the U.S. Geological Survey, and similar information.

In discussing cellulose as a source of motor fuel, the investigators point out that a way must be found to obtain from cellulosic materials a high yield of fermentable sugar when treated with very dilute acids at elevated temperatures and under pressure. It appears that an extended use of alcohol as a motor spirit depends upon the processes which, on the one hand, approach in cheapness the dilute-acid processes, and on the other the almost quantitative yields obtained by using strong acid.

FRANCE.

Industrial Notes.—Chemical Industry.—There has been little activity in the chemical market, but prices have remained steady. Although the demand for fertilisers is still poor, the price of sulphate of ammonia has risen to 110 fr. per quintal (about £22 5s. per long ton at current exchange) owing to greatly diminished importation from England; the cheaper cyanamido is being used in its place. As the agreements between the Kuhlmann and St. Gobain companies concerning the production of superphosphates have not been renewed, it is anticipated that prices will be reduced as a result of the free competition that will ensue, and that this will entail a reduction in the price of basic slag, despite the short supply. The potash situation is very unsatisfactory; Germany is undercutting the market, and in industrial circles it is regretted that an arrangement to fix remunerative prices could not be arrived at by the Alsatian and German producers. State interference is resented, and the general desire is that the working of the Alsatian potash mines should be left to private enterprise.

Fire has destroyed two works at Oyonnax, the manufacturing centre for plastic materials, celluloid, etc. This catastrophe is most unfortunate, as the industry has been in difficulties since the end of hostilities. The only hope lies in modifying the processes employed and particularly in discovering a cheap substitute for camphor, which is stated to have already been done, but kept secret, in Germany.

The Third International Chemical Conference will be held in Lyon from June 28 to 30, 1922, and the Société de Chimie Industrielle will hold its second annual meeting in the same city from July 2 to 6. Members of both bodies will thus be able to visit the Colonial Exhibition which will then be open in Marseille.

Metallurgy.—Signs of revival are apparent throughout the metallurgical industry, and production is responding to the stimulus of a better demand. Twenty-five blast furnaces are now working, including the two which have been blown in recently in the Meurthe-et-Moselle district. Stocks of ore at Briey, Longwy, and Nancy, however, total 2 million tons, and it is hard to see how these can be reduced or production increased until railway rates throughout France and Alsace-Lorraine have been lowered. The fact that German works in the Ruhr district are refusing to buy French ore is ascribed to the unfavourable rate of exchange.

Coal.—The coal market is quiet, and steady progress is being made in reconstructing the devastated coalmines in the Nord and Pas de Calais districts where production has risen to 61.6 and 21.6 per cent., respectively, of the pre-war figures; the former suffered much less during the war than the latter. The German explanation of the reduced delivery of coke is that the intense cold at the end of September hindered transport of coal from the Ruhr area, and that every effort is being made to maintain supplies at the stipulated level.

Rail Transport.—Pending the general revision of the railway rates for goods traffic, the Ministry of Public Works has approved a certain number of reduced rates, especially for metallurgical products. Thus for the carriage of metallurgical products to ports for shipment abroad the reduction is now 40 as compared with 25 per cent., and for semi-manufactures in parcels of 180 metric tons the reduction is 15 per cent.

Collapse of the Lorraine Salt Industry.—Press reports from Metz state that the salt industry in Lorraine has completely collapsed. The well-known Solvay works and the saltmines have closed down and thousands of workers have been discharged. The cause is stated to be the inability of the Lorraine salt industry to find new markets to replace those lost in Germany.—(*Schweiz. Chem.-Z.*, Jan. 10, 1922.)

CANADA.

Minerals and Mining.—Gold-mining is recovering in British Columbia owing to reduction in wages and other expenses.

A rich gold strike is reported from White Water Chilcotin district, B.C. The ore is stated to be telluride.

A rich strike of gold ore, which yielded 183.66 oz. per ton, has been made at the I.X.L. mine, Rossland, Ontario.

The new fields of iron ore in Northern Alberta (cf. J., 1921, 406 R) are located on the northern shore of Lake Athabasca, twenty miles east of Crackingstone Point.

A large body of high-grade copper ore has been struck on the Monarch group, at Beasley, B.C. The ore runs 7 per cent. of copper with gold and silver valued at about \$2.50 per ton.

Great activity prevails in the new silver camp at Mayo City, Yukon, and Galen's Hill, opposite Keno Hill, in the same territory, has been "stampeded." The rich veins discovered at Keno Hill are being developed this winter.

The output of gold ore in 1920 which will be put through the seven largest reduction plants in the Porcupine and Kirkland Lake district of Northern Ontario will approximate to 2 million tons and yield over \$19,000,000 worth of bullion.

The October output of silver from the Nipissing mine, Cobalt, exceeded \$250,000. The company has recently developed a 26-inch vein of very high-grade silver ore which is classed with the richest ever found in Cobalt.

The McIntyre-Porcupine gold mine is to proceed immediately with the installation of equipment which will increase the capacity of the mill by 50 per cent. When the equipment is complete the company will handle 800 tons of ore daily.

Coniagas Mine, Cobalt, produced 1,301,505 oz. of silver during the fiscal year ending October 31, 1921, and sold it at an average of 70.88 cents per oz. The mining and concentration of the ore averaged 33.52 cents per oz., as compared with 48.98 in 1920. The company distributed \$800,000 in dividends during the year, making a total of \$10,840,000 since its inception.

The non-metallic mineral production of Canada for 1920 was as follows:—Actinolite, 100 tons; arsenic, white, 2459 t.; barytes, 751 t.; chromite, 11,016 t.; gypsum, 429,144 t.; magnesite, 18,378 t.; magnesium sulphate, 1947 t.; manganese ore, 649 t.; mica, 2203 t.; natural gas, 16,846 million cu. ft.; pyrites, 174,744 t.; quartz, 128,295 t.; sodium sulphate, 811 t.; talc, 21,671 t.; tripolite, 260 t.; feldspar, 37,873 t.; fluorspar, 11,235 t.; and graphite, 2190 t.

The Tanning Industry in 1918.—The Dominion Bureau of Statistics, in its return upon the leather-tanning industry of Canada for 1918, states that there were 139 establishments engaged in leather-tanning. They were distributed all over the

Dominion, but more than half were situated in the province of Quebec (77) and Ontario had 46. The total value of the products was \$33,079,998, of which \$31,961,555 represented sole, upper, harness, glove, etc. leather and \$1,118,443 by-products such as wool, hair, glue stock, etc. The total amount invested in the industry is given as \$28,435,806, of which the land, buildings, equipment, etc. were valued at \$6,689,575. The average number of persons employed was 3722, and wages and salaries amounted to \$3,464,845. The fuel cost at the plants was \$476,302 and consisted chiefly of bituminous coal. The materials used cost at the works \$23,681,659, of which hides contributed \$19,505,874; extracts, chemicals, dyes, etc. \$2,261,827; tan bark \$550,527; other tanning materials \$1,186,149; and the balance was made up of rough leather which had been purchased. Miscellaneous expenses amounted to \$1,598,862, the chief items of which were insurance \$145,499; taxes \$176,580; power \$75,961; ordinary repairs to buildings and machinery \$248,619; and sundry expenses, not defined, \$824,048. The value of hides, skins, pelts, and leather exported from Canada in 1918 was \$14,324,576.

GENERAL.

Physical and Chemical Survey of the National Coal Resources.—The question of instituting a physical and chemical survey of the national coal resources has been engaging the attention of the Fuel Research Board for some years, and now that the coal industry is in a more settled state, it has been decided to start the work. The study and classification of coal seams are obviously of great importance in the solution of the problem of conserving our fuel resources, and on its directly practical side this study must deal primarily with the suitability of each particular coal for the purpose for which it can be most economically used. The Board believes that such work can be best performed with the aid of local committees, comprising colliery owners, managers, consumers, and representatives of the Fuel Research Board and of the Geological Survey. The selected seams will be submitted to physical and chemical examination by the local experts, and any further investigation required will be undertaken at H.M. Fuel Research Station, or at other works. In pursuance of this policy, the Board has recognised the Lancashire and Cheshire Coal Research Association, which is already at work, as the committee to undertake the physical and chemical survey of the coal seams in its locality.

Colour Photography.—A method patented by Major Klein replaces the tri-colour filters used for process reproduction work in conjunction with the camera lens by projecting selected areas of the spectrum upon the original. The use of a powerful light source in the projection spectroscope is essential. The spectrum may be split up into any number of sharp-cut regions that may be desired, and a corresponding number of process blocks prepared. The difficulty of finding suitable printing inks, however, remains.—(*The Times*, Dec. 27, 1921.)

The China-Clay Industry in S.W. England.—China clay is one of the most widely-used minerals in England and none of the foreign products described as china clays can compete with it, price for price, either in texture or in composition. A century ago the output was only 5000 tons per annum, but in 1870 it reached 100,000 t., rose to 200,000 t. in 1887, and in 1912 attained the record figure of nearly 1 million tons. Roughly nine-tenths of the production comes from Cornwall and the remainder from Devon; about one-twelfth of the Cornish output represents china stone, which is used entirely in making pottery, particularly hard porcelain and china. In 1918 the producers combined to form the Associated China Clays, Ltd., with a capital run-

ning into millions sterling, and the industry, on account of the depression in the other Cornish mining industries, is at the moment the largest producer and employer in the county. The supply is stated to be inexhaustible, and the fact that England is the only country that exports china clay overseas suggests that, normally, foreign competition is not to be feared.

China clay is chiefly used as a filler for newsprint, for coating and glazing art papers, in pottery, in bleaching, and in the manufacture of ultramarine, alum, and other chemicals. In addition to the established use of china clay as a filler for rubber and certain classes of soap, new uses are suggested not only in soap-making but also, in association with rubber and other materials, as a surfacing for roads.

The industry has not prospered since 1913; during the first six months of 1921 exports were only 88,096 tons, compared with 356,868 t. for the same period of 1913. A welcome revival has set in during the past few months, but the total exports for the period January–October, 1921, were more than 200,000 t. lower than in the corresponding period of 1920. Prior to the war the United States was the largest consumer of Cornish china clay, taking over 250,000 tons per annum, of which more than three quarters was used in paper-making.—(*Times Tr. Suppl.*, Dec. 31, 1921.)

Sugar Cultivation in British Malaya.—The report of the Director of Agriculture in British Malaya for 1920 describes the efforts made to encourage the cultivation of sugar-cane in the Malay Peninsula, for which a Government committee was appointed to report on the advisability of granting facilities with a view to re-establishing the industry on a permanent basis. A collection of locally-grown canes has been planted at the Experimental Station at Kuala Lumpur, and steps have been taken to introduce the best canes grown in the chief sugar-growing countries in the tropics. Suitable land is being reserved and offered on special terms for sugar-cane cultivation. Apart from the possibility of cultivating sugar for export, a good market could be found locally if facilities for refining were provided. Of the 97,310 tons of sugar, valued at £3,815,976, imported from the Dutch East Indies into the Straits Settlements in 1919, 65,938 t. was re-exported, including 13,051 t. to the Malay Peninsula. The import of sugar into the Federated Malay States in 1920 was 7379 t., worth £530,700.—(*Bl. of Trade J.*, Dec. 8, 1921.)

The Essential-Oil Industry in Seychelles.—Considerable progress has been made in the distillation of essential oils, the exports in 1920 amounting to:—*Ocimum-viride* oil 39 kg., cinnamon-leaf oil 39,507 kg., clove-leaf oil 3109 kg., and lemon-grass oil 4 kg.; and 2950 kg. of ambrette seeds (*Hibiscus abelmoschus*). Ambrette seeds are not distilled on the spot owing to the difficulty of preserving the oil without alteration at a great distance from the market. The progress of the cinnamon-leaf distillation was enhanced by the facilities afforded to the distillers for cropping leaves on Crown lands at the fixed rate of Rs. 7.50 per ton of cinnamon leaves and Rs. 35 per ton of clove leaves. Towards the end of the year the market price of cinnamon oil fell to Rs. 4 a kilo, instead of Rs. 12, and many distilleries were closed, thus lowering by about one-third the total production during the year. The demand for cinnamon-leaf oil on the European market practically ceased, and the industry suffered a severe blow. Although the sudden drop in the value of this commodity has not yet been explained, it is thought to be due to the preparation in Europe of synthetic vanillin from substances other than eugenol. Vanillin was also manufactured before the war from coniferin, derived from buds of conifers, and it was thought that, as there was then

a great demand for cinnamon-leaf oil containing 80 to 92 per cent. eugenol, it was cheaper to manufacture vanillin from eugenol than from coniferin. The fall in price of cinnamon oil was felt very severely by those planters who had taken up the distillation of cinnamon leaves in the hope of recouping themselves for the loss of their vanilla plantations. They are now turning their attention to other industries, but there is not much scope for the manufacture of articles which cannot be easily overproduced, such as essential oils. As it is important that the up-to-date distilleries should not remain closed, steps are being taken to develop plantations of lemon grass, *Ocimum viride*, and patchouli.—(Official.)

German Deliveries of "Reparation" Chemicals.—According to a recent publication entitled "Consequences to Ourselves and Others of the Depreciation of the Mark," by Drs. H. Behnken and W. Ganzmer (Meiner, Leipzig), the value of the dyestuffs, ammonia, chemical and pharmaceutical products delivered by Germany to the Allies under the Reparation Clauses of the Peace Treaty amounted to 31 million gold marks up to April 1, 1921.

The Soldering of Aluminium.—The Deutsche Gesellschaft für Metallkunde is offering two prizes of 15,000 and 5000 marks, respectively, for solders (alloys) or processes for soldering that permit of soldering aluminium or alloys high in aluminium, such as duralumin, in a satisfactory technical manner. Only German subjects may compete and the successful competitor will retain his priority right in the solder or process discovered.—(Chem.-Z., Dec. 15, 1921.)

A New Light Alloy.—An alloy called "Silumin" consisting of 11–14 per cent. of silicon and 89–86 per cent. of aluminium was shown by the Metallbank u. Metallurgische Gesellschaft of Frankfurt at the last Automobile Exhibition in Berlin. Its sp. gr. is 2.5–2.65, tensile strength 20 kg. per sq. mm., hardness at room-temperature 60 kg. per sq. mm., and at 350° C. 20–25 kg. per sq. mm. (with a 500 kg. load and a 10 mm. ball). The alloy is unattacked by wet steam, and less affected by 25 per cent. and concentrated nitric acid than aluminium, which it otherwise resembles chemically. Silumin is made either directly from its elements, with certain additions, or in the electric furnace.—(Chem.-Z., Dec. 22, 1921.)

Synthetic Alcohol in Germany.—The schedules to the Spirit Monopoly Bill give, for the first time, information concerning the production of alcohol in German factories other than distilleries. The process involving synthesis from calcium carbide seems most in favour, and has been used by the Badische Anilin- und Sodafabrik since the end of 1920 to produce alcohol required in making "reparation" dyestuffs. During the first quarter of 1921, this company manufactured 22,000 galls. of ethyl alcohol by this process at Ludwigshafen, where the capacity of the plant can be increased up to about 660,000 galls. per annum. An experimental factory, now under construction at Burghausen, Bavaria, is to produce roughly 219,975 galls. of alcohol annually by the carbide process. There are now only ten factories making sulphite spirit; these produced 726,000 galls. in 1920 and 660,000 galls. in the first half of 1921. The last experimental factory for making wood alcohol has been closed, presumably because the manufacture was not economic.—(Chim. et Ind., Nov., 1921.)

The German Sugar Industry.—Conditions in the German sugar industry during the year ended August 31, 1921, were distinctly better than in 1919–20, which was probably the worst year in the history of the industry. Not only was the acreage under sugar-beet much greater but the yield of beets per acre increased by 37 per cent., the average

sugar-content rose from 14.81 to 16.62 per cent., and the total output in terms of raw sugar was higher by 55 per cent. This increase in production corresponded with the augmented consumption in the previous year. Taxed sugar, i.e., sugar intended for human consumption, increased by 26 per cent., inclusive of imported sugar, which has been free from import duty since 1915 and treated in the same way as home-produced sugar. Imported sugar upon which tax was paid in 1920–21 amounted to 35,309 t., compared with 60,083 t. in the previous year. Sales of duty-free sugar were 505.7 t., of which 449.6 t. was imported. Prior to the war imports of sugar were negligible compared with the home production and consumption, but in 1918–19 they amounted to 39,400 t., and in 1919–20 to 98,700 t. (calculated as raw sugar); even these figures, however, are very small compared with those of the consumption of domestic sugar.

Exports in the calendar year 1920, viz., 1376.9 t. of raw sugar and 4551.7 t. of sugar for consumption, were directed almost exclusively to the Saar district, a little going to Heligoland and Danzig; in 1913 the figures were 530,000 t. and 590,000 t., respectively. No sugar was exported to other European countries, and any entries in foreign statistics showing imports from Germany are misleading, inasmuch as in such cases the sugar was merely transhipped at German ports.

Statistics of production etc. for the past 8 years are given in the appended table:—

Years.	Area.	Roots worked.	Output of raw sugar	Taxed sugar (sugar for consumption)
	A-res.	100 metric tons.	100 metric tons.	100 metric tons.
1913-14	..	215,639	.. 16,940.0	.. 2,715.9
1914-15	..	221,261	.. 15,964.5	.. 2,510.1
1915-16	..	117,523	.. 9,625.1	.. 1,515.3
1916-17	..	40,607	.. 9,570.8	.. 1,557.9
1917-18	..	155,634	.. 9,229.9	.. 1,511.1
1918-19	..	118,328	.. 8,709.0	.. 1,327.7
1919-20	..	105,884	.. 4,960.9	.. 717.0
1920-21	..	112,769	.. 6,536.1	.. 1,091.8

New Superphosphate Factory in Holland.—The new superphosphate factory at Vlaardingen, between Rotterdam and the Hook of Holland, started operations in August, 1921, and has lately been producing 300 tons of superphosphate daily. As this represents only about half the capacity of the plant, it is intended to export to South Africa and other countries south of the equator where the demand for superphosphates is greatest when the demand in Holland is least. The membership of the co-operative association that owns the factory includes 9000 farmers, and every shareholder is obliged to buy a metric ton of the output.—(Bull. Dept. Tr. and Comm., Can., Nov. 28, 1921.)

The Copper Mines of Eastern Finland.—The deposits of copper ore at Outokumpu, situated in the Kuusjärvi district, 35 miles from Joensuu, and discovered in 1910, are said to contain at least 8 million tons of ore in sight which averages copper 4.0–4.5%, sulphur 27%, iron 28%, zinc 1%, and small quantities of silver and gold. Notwithstanding their magnitude, the mines have never been worked with much success; production in 1914 was 7500 tons of ore and 148.2 t. of copper, in 1916 22,000 t. and 175.8 t., and in 1919 11,000 t. and 15.6 t., respectively. It is stated that the present monthly production of ore is sufficient to supply the smelting plant for one year, but that the smelting capacity is to be doubled. Recently negotiations have been taking place between the owners, the Finnish Government and a private firm, and owners of copper mines in Germany for the lease of the Outokumpu mines or for the sale of the crude ore to the latter, but the proposal is meeting with much opposition in Finland.—(U.S. Com. Rep., Dec. 19, 1921.)

Mineral Production in Sweden in 1920.—Statistics of the output of minerals and metals in Sweden during 1920 have been issued by the Swedish Commercial Board. The chief items include:—

	Metric tons.
Iron ore	4,519,112
Iron, pig	470,550
Ferro-silicon	6,281
Iron, malleable, and steel, semi-manufactured	610,368
Ores:—	
Silver and lead	2,901
Molybdenum	0.6
Tungsten	30.5
Copper	1,136
Manganese	14,926
Zinc	47,674
Graphite	7
Pyrites	107,326
Metals, non-ferrous:—	
Lead	863
Copper	1,289
Zinc	5,759
Sodium	165
Coal	439,584

Despite the decline of 9.3 per cent. in the production of iron ore and of 4.3 per cent. in that of pig iron, the total value of the products of the iron and steel industry rose by 16,159,229 kronor to 311,618,086 kr. (kr.=1s. 1½d. at par). The output of the other ores was valued at 8,204,827 hr. There was a small production of gold and silver, viz., 7 and 359 kg., respectively.—(*Bd. of Trade J.*, Dec. 1, 1921.)

The Metric System in Russia.—From January 1, 1922, the metric system of weights and measures is to be used in all Government departments, and from January, 1921, in trade and commerce generally.

Radium Production.—More radium mineral is produced in the United States than in the whole of the rest of the world, but the surface layers of the carnotite deposits in Colorado and Utah are for the most part exhausted and the accessible ore will probably last for only 6 to 10 years; if the winning of radium is to continue profitable a cheaper method of extraction must be found or the price must be raised. The world's stock of pure radium is estimated at from 100 to 110 grams, of which about 70 gm. was extracted in the United States and much of the remainder from Mexican ores. The supply in the United States for therapeutic use is about 20–25 grams.—(*Edel-Eden u. -Erze.*, Nov., 1921.)

Austrian Magnesite.—About 90 per cent. of the Austrian production of magnesite—chiefly from the Steiermark district—is exported; before the war it was sent mainly to the United States, but latterly Germany has been the chief purchaser, and since June, 1921, the revival of the German iron and steel industry has led to a notable increase in the demand. In 1920 the total export of Austrian magnesite was 62,530 metric tons, of which 29,059 t. was sent to Germany, and 19,500 t. to the United States; in the first half of 1921, 40,000 t. was exported, against 22,431 t. in the corresponding period of 1920. Large quantities are also exported to England, France, Czechoslovakia and Italy.

British Chemical Plant Manufacturers' Association.—This Association has just issued its first Directory (1922) containing a list of its officers, a short introduction by the chairman, Mr. J. H. Rawson, a directory of members, and a classified list of products and manufactures. Copies may be obtained at the offices of the Association (166, Piccadilly, London, W. 1) at a charge of 5s. per copy.

The Institute of Metals.—The annual meeting will be held in London on March 8 and 9, the May lecture will be delivered on May 3 by Sir Ernest Rutherford on "The Relation of the Elements," and the autumn meeting will be held from September 20 to 22 in Swansea. The Institute has made remarkable progress during the past year, its membership having increased from 1293 to 1410, in spite of the industrial depression.

LEGAL INTELLIGENCE.

RAILWAY TRANSPORT OF HYDROGEN PEROXIDE. *Great Northern Railway Co. v. L. E. P. Transport and Depository, Ltd.*

In the King's Bench Division on January 12, before Mr. Justice Horridge, the Great Northern Railway Co. sued the L. E. P. Transport and Depository, Ltd., of London, for breach of warranty over the carriage by plaintiff's railway from Tilbury to Luton of "oxygenated water" in glass carboys. The plaintiff company's case was that this liquid was a concentrated solution of hydrogen peroxide, which was usually supplied and transported in strengths of 10, 12, or 20 volumes; but a foreign firm supplied it of 100-volume strength and containing additional sulphuric acid, and this was highly corrosive. A quantity sent from Zürich to Tilbury was forwarded by the defendant company over the Great Northern Railway to Luton, the goods being described as "oxigine" water in carboys. The stoppers of some were destroyed by the liquid, certain carboys were overturned, and the liquid damaged hat bodies or hoods that were carried in the same trucks. The railway company compensated the owners of the hat bodies and now sued the L.E.P. Co. Counsel for the railway company contended that the sending of the goods in this way implied a warranty that they were not dangerous. The liquid was known as "Perhydrol."

The defence was that there was no breach of warranty, that the goods were received by the defendant company as common carriers without special terms, and they were not liable.

Mr. W. M. Young, analyst to the Great Northern Railway, gave evidence that a solution of 20 volumes would be very corrosive, and counsel for defendant company stated that hydrogen peroxide was not in the "dangerous" list of the railway company's schedule. Mr. L. Archbutt, chief chemist to the Midland Railway Co. and chairman of the committee of railway chemists, said hydrogen-peroxide solution had been carried in carboys for many years and until this case he had never heard of the transit of a solution of 100-volumes strength in carboys in this country. The strength the companies were carrying was up to about 20 volumes. Experiments on hat-felt fabric with 20-volume strength and with perhydrol had shown that the former bleached the fabric but did not destroy it, and that perhydrol of 117 volumes destroyed the fabric and caused great shrinkage. The 100-volume strength gave the same result as the 117. Mr. I. E. Weber, head chemist to Laporte, Ltd., chemical manufacturers, said that his company produced at Luton 12,000 to 15,000 gallons per week of hydrogen peroxide, or 60 per cent. of the whole production of the country. The strengths made were 10, 12, 16, and 20 volumes; a solution of 100 volumes would make felt brittle and destroy the fibres. All solutions of commercial hydrogen peroxide up to 20 volumes contained some sulphuric acid—0.03 to 0.04 per cent. A sample of the 100-volumes solution showed 0.96 per cent. sulphuric acid, and in transporting this cork and wood stoppers would have to be specially waxed or treated and a tube used as a vent hole. His company had received from abroad the solution up to 100-volumes strength. For the defence, evidence was given that the carboys were in good order and had waxed corks with a vent and cap.

Mr. Justice Horridge said that he was satisfied that the solution in question would cause serious damage to organic matter and that it did damage the hoods. On the question whether there was a warranty by the defendant company that the goods were not dangerous, he was of opinion that the railway company had to carry the goods because of its

statutory position and there was a corresponding warranty by the defendant company that the goods were not dangerous. He decided the goods were dangerous and that there was a breach of warranty. It seemed to him, however, that the railway company would only be liable to the owner of the fets for its own negligence. Therefore the railway company could not succeed here, for it had not shown that it was responsible to make the payment; it was either a voluntary payment or one made in respect of its own negligence. Therefore there must be judgment for the defendant company; but as the cost had been mainly incurred on the issue of whether the goods were dangerous, he would award to the defendants the ordinary costs and to the plaintiffs the costs of the issues on which they had succeeded.

REPORTS.

FIRST REPORT OF THE GAS CYLINDERS RESEARCH COMMITTEE. *Department of Scientific and Industrial Research.* Pp. 126. London: H.M. Stationery Office. Price 7s. 6d.

There are at present no statutory regulations controlling the manufacture and transport of cylinders for compressed gases. In the matter of such transport, the railway companies, prior to the introduction of mechanical road transport, were able to enforce the terms of an agreement reached between them and the compressed-gas trade, which were endorsed and amplified by a Home Office Committee in 1895. In view of the great progress in metallurgy and engineering since that date, the view was expressed that the restrictions imposed by such terms were excessive, and the present research committee was appointed in November, 1918, "to re-examine the whole question of cylinders for the storage and transport of compressed gases other than acetylene, including the standardisation of the fittings of gas cylinders, and to undertake the necessary experimental investigations."

The present report deals exclusively with cylinders for storing "permanent" gases; the transport of gases in the liquid state, and the standardisation of gas-cylinder fittings will be reported upon later. A majority report signed by eleven members of the committee, and a minority report signed by the remaining member are contained in the report. The committee is unable to recommend, at this stage, the use of non-ferrous alloys or special alloy-steels for the manufacture of gas cylinders. *Inter alia*, the majority report recommends that gas cylinders should be manufactured of solid drawn steel having the following composition: carbon, 0.43–0.48% (compared with 0.25% under previous regulations); sulphur, not above 0.045%; phosphorus, not above 0.045%; manganese, from 0.5–0.9%, and silicon not above 0.3%. Cylinders, after manufacture, are to be heated throughout in a furnace to a temperature between 820° C. and 850° C. After removal from the furnace, at that temperature, they are to be cooled in still air. One finished cylinder in each batch, or one cylinder in every hundred when the number in a batch exceeds one hundred, must be submitted to mechanical tests, including specified tensile, flattening and impact tests. Before the necking operations, each cylinder should be examined for maximum and minimum thickness, and for external and internal surface defects. The maximum working pressure is, for the present, to be 120 atmospheres, and the stress due to such pressure must not exceed 10 tons per sq. in. Each cylinder must be submitted to a hydraulic test involving the application of a proof pressure of 200

atmospheres, at least once in two years, and the permanent stretch of the cylinder when submitted to such test must not exceed 10 per cent. of the elastic stretch. Cylinders should be periodically examined for corrosion and surface defects, and need not be protected by coir mats, provided the valves are furnished with screwed-on caps.

The minority report reaffirms the desirability of imposing the recommendations laid down by the Home Office Committee referred to above, and urges that experience at home and abroad confirms the contention that the thinner-walled cylinders made of the higher carbon steel (recommended in the majority report) will not be as uniformly safe as the stouter cylinders made of milder steel in accordance with the Home Office recommendations. Further, these recommendations should be amended in accordance with Appendix III. of the Report of the Inter-Departmental Committee on Gas Traction (*cf. J.*, 1919, 297 R).

Appendices to the present report are devoted to: a summary of the recommendations of the 1895 committee concerning the storage and transport of the "permanent" gases; comparison of regulations for cylinders for "permanent" gases in Great Britain, the United States, Germany, and France; reports of tests at the National Physical Laboratory on cylinders of high carbon steel and light aero-oxygen cylinders; a précis of evidence taken before the committee; the Admiralty specification for the manufacture of flasks for hydrogen. There is also a note on the deviation of technical gases from Boyle's Law, in which it is interesting to observe that the relative volumes occupied by equal volumes of the compressed gases hydrogen, oxygen, nitrogen, air, and carbon dioxide, when the pressure is reduced to atmospheric from 120 atmospheres, are respectively 111.3, 127.2, 120.0, 121.9, and 485. Thus, it is pointed out, a purchaser buying hydrogen measured according to an accurate pressure gauge would be receiving, if the cylinder had its nominal capacity at the usual working pressure of 120 atmospheres, only 92.7 per cent. of his proper amount, and if the pressure were higher a still smaller proportion. For oxygen, under similar circumstances, he would receive about 6 per cent too much.

REPORT ON THE ECONOMIC AND COMMERCIAL SITUATION IN ALGERIA, DATED AUGUST, 1921. *By J. K. V. DIBLE, Acting British Consul-General, Algiers.* Pp. 66. Department of Overseas Trade. H.M. Stationery Office. 1921. Price 2s.

Algeria remained unaffected by the economic crisis until June, 1920, and since September of that year, when its full effects were experienced, there has been little indication of improvement. As Algeria is predominantly an agricultural country, it would probably have suffered little but for the disastrous failure of the cereal crops and the slump in wine and alcohol; and added to these causes was the inadequate transport system. Drought was the cause of failure of the chief crops of 1920 and heavy rains in 1921. Most of the vegetable-fibre factories were closed owing to absence of foreign demand, but exports of esparto improved in 1920 owing to the use of motor transport (90 per cent. went to the United Kingdom). The factory of the Société des Celluloses de l'Afrique Française du Nord (capital 2 mill. fr.) was expected to start producing paper pulp, etc. from esparto and other raw material in September, 1921. Sales of cork were very small and the attention of British merchants is directed to this product.

Despite ample supplies of labour, freed by the failure of the harvest, the mining industry was almost stagnant, and owing to the fall in prices of base metals most of the mines accumulated heavy stocks of ore. New concessions for mining ores of zinc,

lead, arsenic, and for petroleum have been granted; much money has been spent on prospecting for oil in the Department of Oran, but the output has been very small (mainly in the Tilouanet district near Relizane) and prospects are not promising. Tenders for the exploitation of the important phosphate deposit at Djebel-Onk will be invited as soon as the projected railway to carry the mineral to the coast has been declared to be of public utility. A coalmine at Kenadsa is being worked by the State railways and the present daily output of 20 tons is to be increased. Large deposits of kieselguhr, apparently of excellent quality, were discovered in 1920 near St. Denis-du-Sig, 25 miles from Arzeu, and small shipments were made to the United Kingdom. Owing to the discovery of a local supply of kaolin, a factory (Fabrique Nord-Africaine de Céramiques) has been started at Maison Carrée, near Algiers, and is producing serviceable porcelainware; this is the first of its kind in Algeria. Exports of minerals, particularly iron ore and phosphate, increased during 1920 (*cf. J.*, 1921, 330 n), and a new market, viz., the United States, was found for iron ore from Benisaf.

Imports in 1920 were valued at 2,535,168,000 francs (including manufactured goods worth 1,686,712,000 fr.), of which the United Kingdom supplied 576 per cent. Of the exports, worth 1,441,577,000 fr., 225 per cent. was directed to the United Kingdom. (For trade in chemical and allied products *cf. J.*, 1921, 335 n). At the time of writing the market was overstocked with goods bought before prices fell. Openings could probably be made for rubber tyres, building accessories, inks, certain iron and steel products, etc. Coal, coke and patent fuel sell readily, and the expanding trade in mineral oil should receive the attention of British firms.

INTERIM REPORT OF THE DOMINION CHEMIST, F. T. SHUTT, FOR THE YEAR ENDING MARCH 31, 1921. Pp. 67. Ottawa: Department of Agriculture, Dominion of Canada.

The work done by the Division of Chemistry, Department of Agriculture, consists of agricultural research, advisory and analytical work for farmers, and control analyses for other Government Departments. The research work, which was interrupted during the war, has been resumed, and covers trials of different mixtures of fertilisers, with and without the application of lime, on potatoes, oats, wheat, and clover hay, and a determination of the amount of nitrogen brought down by rain and snow in the Ottawa district. The total nitrogen precipitated in the year was 6523 lb. per acre, of which 80 per cent. was in the rain and 20 per cent. in the snow. Of this total nitrogen, 4874 lb. occurred as free and organic ammonia and 1649 lb. as nitrates. Work for the land reclamation service and on the loss on scouring of various grades of wool is briefly recorded.

A very full investigation has been conducted into the growth of sugar-beets for the manufacture of sugar, including variety trials carried out on numerous different types of soil, and a study of the effect of the season and climate on the yield of sugar. The results indicate that the quality of the beets depends chiefly on the temperature. The sugar content and purity decline when the mean minimum temperature for the season falls below 45° F. Conditions are favourable when the mean temperature exceeds 60° F. Other crop trials include variety trials on mangels, turnips and carrots, the effect of the stage of ripening at harvesting on the nutritive value of the straw of wheat and oats, the influence of early planting on the quality and yield of potatoes, and the use of various green crops for silage.

The examination of flour samples, representative of flour shipments for consumption overseas, which

was first undertaken for the British War Office in 1915, and continued in 1917 for the Wheat Export Company, and still more recently for the Canadian Wheat Board, was brought to a close in August, 1920. In all 11,513 samples have been examined, and the work has been the means of saving to the Empire very large sums of money, and further, by controlling the moisture content of flours, has ensured the arrival overseas of the flour in excellent condition.

During the year the Division analysed 3734 samples, including 560 samples of soil, 121 of manures and fertilisers, 365 of feeding stuffs, fodders, etc., 251 of waters, including rain and snow, 1279 from the Meat and Canned Foods Division, which included samples taken under the Oleo-margarine Act, 773 of flour, and 385 miscellaneous samples comprising dairy produce, wools, insecticides and fungicides.

REPORT ON THE RELATION OF THE NITROGENOUS MATTER IN BARLEY TO BREWING VALUE. By H. F. E. HULTON. *Journal of the Institute of Brewing (Supplement)*. Pp 33—142. January, 1922.

This report was undertaken at the instigation of the Advisory Sub-Committee on Barley appointed under the Research Scheme of the Institute of Brewing (*cf. J.*, 32, 256, 370 n), and it refers more particularly to the relation of nitrogen to (1) size of grain, (2) amount of (malt) extract, and (3) the character of (malt) extract, and also to the quantity and character of the nitrogenous matter present in barley in relation to its value as a brewing material. Owing to the extent of the field covered it was found necessary to treat the subject-matter under twenty-one headings, and the following brief summary of the sections into which the report is divided will give some idea of its scope:—Composition, character and quantity of nitrogen in barley and malt; conditions affecting the nitrogen content of barley; evaluation of barley from its nitrogen content; and the relations between the nitrogen content and various characteristics of barley.

To summarise the enormous quantity of published work dealt with by the author would be impossible, but the following points upon which most workers are in agreement may be detailed:—Factors contributing to the production of a high nitrogen content in barley: Too rapid or delayed maturation, hot and dry seasons, wide planting, soil too rich or too heavy, excessive use of unmixed nitrogenous or nitrate fertilisers, large and coarse corns, and the original strain or breed having high nitrogen content. The following qualities are usually associated with barleys of high nitrogen content: High tillering rate when sown, lower ratio of grain to straw, lower extract from resulting malt, defective maturation, steeliness, lower bushel weight, larger corns and higher density, tendency to heat, greater loss by respiration and sluggish modification during malting, higher nitrogen in finished malt, higher uncoagulable proteins in wort, tendency to fret and haze, and better head retention in finished beer. Since most of these qualities are undesirable, the author asks if the nitrogen content of a barley can be taken as a measure or criterion of "desirability," and further on he shows that until much more exact knowledge is obtained concerning the character and behaviour of the proteins and their cleavage products from the points of view of the maltster and the brewer, little progress can be made in the breeding of barley having some particular character and content of protein.

The report is provided with a bibliography and name-index, and the table of contents on page 31 serves the purpose of a subject-index.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for January 12 and 19.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Canada	Asbestos tape	28
"	Paints, oil colours	63
"	Keene's cement	"
South Africa ..	Leather	72
Belgium	Thiplate	73
"	Imitation leather	74
Belgium and Luxemburg	Ferro-silicon, ferro-manganese, spiegeleisen, etc.	37
Denmark	Coal-tar dyes, chemicals for the textile industry	39
France	Vulcanised fibre, balata and rubber belts	75
Norway	Raw hemp and flax	42
Spain	Chemicals, drugs, paint	43
Switzerland ..	Castor oil	45
United States ..	Industrial chemicals	52
"	Heavy chemicals (especially caustic soda, soda ash) ..	53
Argentina, Uruguay, Brazil, Chile ..	Perfumery	56
Mexico	Drugs, pharmaceutical products ..	60
"	Perfumery, essential oils ..	61

* Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

TARIFF. CUSTOMS. EXCISE.

British India.—The revised import and export tariff valuations are given in the issue for January 19. Metallic ores, manures, fertilisers, and wood pulp are in the free list; a duty of 11 per cent. is levied on gums, lacs, resins, wax, explosives, chemicals, drugs, medicines, dyes, colours, paints, tanning materials, hides and skins, etc., and of 2½ per cent. on most metals and manufactures thereof. The duties are applicable either on an *ad valorem* basis or on the tariff valuation.

Canada.—A duty to prevent dumping has been applied to bars, rods, strips, sheets, or plates of copper, brass, nickel silver and German silver.

The operation of the regulations requiring imported goods to be marked with the name of the country of origin has been suspended until after the next session of the Canadian Parliament.

Czechoslovakia.—Information on the revised "coefficients of increase" applied to certain imports can be obtained from the Department.

Ecuador.—Rubber may now be exported duty-free.

Federated Malay States.—As from November 24, 1921, revised export duties, increasing with the price, are applicable to rubber.

France.—Increased import duties are payable on lubricating oils, heavy oils, and residues of petroleum and other mineral oils (with exceptions).

Special authorisation is not required for the export of sugar of foreign origin and of industrial alcohol.

French West Africa.—The "coefficients of increase" applied to imported spirits, wines and alcoholic perfumery have been raised, but the coefficient affecting matches has been lowered. Other coefficients, whether applied to imports or exports, remain unchanged.

Hungary.—The surtax when customs duties are paid in paper money on goods in list "B" is raised to 3900 per cent. (i.e., 40 times the nominal tariff rate), and on goods in list "C" to 7900 per cent. List "C" includes sugar, paraffin, degrass, oleic acid, various vegetable and mineral oils, iron and steel wire, candles, soap, matches, etc. The surtax on goods in list "A" remains at 11,000 per cent. The import-free list now includes lactose, cacao, molasses, oils, yolk and white of egg, wax, raw fats, hides and skins, certain minerals, gums, resins, paper and rubber wares, glassware, stone and earthenware, common metals and wares thereof, and various chemicals, dyes, varnish, colours, fertilisers.

Italy.—The import duty on newsprint paper is fixed at 5 lire (gold) per 100 kg., as from January 1.

Norway.—Certificates of origin are required for imported cacao beans, kitchen salt, etc.

Paraguay.—The duty on imported Roman cement has been reduced from 22 to 12 per cent. *ad valorem*. Quebracho logs have been placed on the duty-free list, and newsprint paper has been removed from it.

Rumania.—Export prohibitions have been temporarily applied to zinc, brass, coal, coke, petroleum and certain of its products. Special authorisation is required for the export of animal fats, bones, cement, pyrites, cellulose, pig iron, iron ore, ferro-manganese, copper, caustic soda, paraffin wax, etc.

South Africa.—Rebate of duty is allowed on pigments, fillers, vulcanising accelerators, vulcanised oils, compounding oils, solvents, etc. imported in bulk for use in manufacturing rubber.

Spain.—Proofs of origin are required for goods shipped *via* French ports or territory from countries entitled to "second column" rates of the Spanish tariff.

Switzerland.—Export duties have been modified on scrap iron, rags, and waste paper.

Trinidad.—The customs duties on various alcoholic beverages have been amended.

Tunis.—The import duty on malt is fixed at 15 per cent. *ad valorem*. The "general" tariff rates on "vitrifications" have been modified.

GOVERNMENT ORDERS AND NOTICES.

CENSUS OF PRODUCTION (1923) ORDER, 1921.—This order has been made by the Board of Trade under the Census of Production Act, 1917, and provides that a census of production shall be taken in 1923 respecting the production during 1922.

TRADE MARKS IN PALESTINE.—The Trade Marks Ordinance, 1921, which came into force in Palestine on January 1, provides for the registration of trade marks in that country and repeals the existing Ottoman trade-mark law. A copy of the Ordinance can be consulted at the Patent Office Library.

PROTECTION OF INVENTIONS IN LATVIA.—A copy of the law, published in Riga on December 29, 1921, amending the former Russian Industrial Law of 1913 and providing for the registration of patents, models and trade marks, together with Regulations prescribing fees to be paid, can be inspected in the Patent Office Library, 25, Southampton Buildings, London, W.C. 2.

INDUSTRIAL PROPERTY IN CUBA.—The Cuban Government has notified its adhesion to the International Convention for the Protection of Industrial Property of 1883, as revised in 1900 and 1911, to the arrangement, dated 1891 and revised in 1911, for the repression of false trade marks on goods; and to the arrangement of 1891, revised in 1900 and 1911, for the international registration of trade marks.

TRADE NOTES.

BRITISH.

Foreign Trade of the United Kingdom in 1921.—Statistics are appended to show the value of the foreign trade of the United Kingdom in chemicals and allied products during 1920 and 1921.

	Imports.		Exports of U.K. produce and manufactures.	
	C.i.f. value. £1,000 sterling.		F.o.b. value. £1,000 sterling.	
	1920.	1921.	1920.	1921.
Chemicals, drugs, dyes and colours ..	34,320.5	12,682.2	40,535.7	19,057.3
Oils, fats and resins, manufactured ..	76,853.3	56,589.2	13,626.4	5,230.4
Leather, and manufactures of ..	20,445.1	8,666.5	11,664.9	4,760.5
Paper and cardboard ..	30,243.7	11,601.3	12,810.4	7,736.4
Rubber manufactures ..	7,102.5	4,919.7	11,520.2	4,662.4
Earthenware, glass, abrasives, etc. ..	11,113.2	7,014.3	18,290.7	12,080
Iron and steel and manufactures of ..	20,016.7	22,887.4	128,907.4	63,772.4
Non-ferrous metals and manufactures of ..	39,132.6	18,467.6	25,781.8	11,733.7

—(Bd. of Trade J., Jan. 19, 1922.)

St. Vincent in 1920.—The general depression in the Colony in 1920 was due to the poor prices obtained for cotton, syrup, and arrowroot, the three main sources of wealth. The area under cotton was increased by 1332 acres to 7965 acres; Sea Island cotton was grown over 6453 acres, the output was 614,508 lb., and 475,650 lb. was exported. Only a small quantity of sugar was made, and the export was 185,999 gallons of syrup and molasses, valued at £27,828. The export of arrowroot was 1247 t., worth £52,771, and that of groundnuts 12,017 bushels, worth £10,816. The total exports, which also included cottonseed oil (£2217) and cassava starch (£3814), were valued at £294,054, of which 73 per cent. was shipped to the United Kingdom. Imports were valued at £257,230, and were derived mainly from the United Kingdom (32.5%), the United States (28.3%), and Canada (27.6%).—(Col. Rep.-Ann., No. 1094, 1921.)

FOREIGN.

The Paint and Varnish Market in Algeria.—Paints and varnishes are imported principally from France, Belgium, England, and the United States, in the order named. In 1919 the imports were 69 metric tons of varnish, valued at \$93,026, and 782 t. of paints, worth \$443,128; and in 1920, 253 t. of varnishes (\$343,540) and 1860 t. of paint (\$948,788). The market is considered an excellent one.—(U.S. Com. Rep., Oct. 31, 1921.)

Proposed Fertiliser Combine in the United States.—Some 35 independent companies manufacturing fertilisers propose to form a combine with the object of effecting economies by concentrating operations at certain plants and closing other plants until conditions improve. Among the companies interested in the movement are the Davison Chemical Co., Piedmont-Mt. Airy Guano Co., and G. Ober and Sons, all of which operate plants in the vicinity of Baltimore, Md.—(Chem. & Met. Eng., Jan. 4, 1922.)

The Carbide Industry in Dalmatia.—Competition in the carbide industry has become much keener and the cartel which formerly included all the Austro-Hungarian makers no longer exists; hence prices have fallen. Owing to the poor market in Dalmatia and Bosnia and the almost prohibitive import duty in Italy, the factory in Jaice has closed down and the factories in Almissa and Spalato belonging to

the "Sufid" Co. (Dalmatian Water-Power Development Co.) have greatly curtailed production. The price f.o.b. Trieste has been about £10 10s. per ton (at current rate of exchange) for several months.—(Schweiz. Chem.-Z., Jan. 10, 1922.)

Glycerin in Japan and China.—All the glycerin used in Japan before the war was imported from the United States and Europe, but during the war a factory was established with Government assistance, so that importations are now smaller. Originally the Japanese manufacturers used only fish-oil as raw material, but to this they have added tallow, vegetable wax, coconut oil, and bean oil.

Imports of glycerin into China in 1920 increased in value to 107,000 Hk. tael (£36,328 with the Hk. tael at 6s. 9½d.), of which the United Kingdom supplied 56, Japan 23, the United States 10, and Holland 3 per cent. Shanghai takes about 63 per cent. of the total Chinese imports of glycerin.—(U.S. Com. Rep., Nov. 14, 1921.)

Prices of Sulphate of Ammonia in Germany, December, 1921.—Concurrently with the diminished production of coal-tar by-products (owing to the shortage of sulphuric acid), they have been in exceptionally strong demand. In consequence of dearer raw materials, prospective increases in wages, and the rise of 50 per cent. in railway rates from December, it has been decided to raise the maximum price of sulphate of ammonia (N=20.58%) by 258 marks per metric ton, and that of the dried and ground material (N=20.80%) by 264 mk., thus bringing the prices up to 5309.6 and 5491.2 mk. per ton, respectively. Assuming 800 mk.=£1, these prices are equivalent to about £6 15s. and £7 per long ton, respectively, and compare with about £14 10s. per ton in the United Kingdom.

COMPANY NEWS.

THE ANGLO-PERSIAN OIL CO., LTD. is issuing 2 million 8 per cent. cumulative preference shares at 21s. and 600,000 ordinary shares at £3 5s. per share, thus raising the share capital to £18,600,000.

SOUTH AFRICAN CARBIDE AND BY-PRODUCTS, LTD.—Labour troubles have seriously hindered the completion of this company's plant in Natal. The erection of five of the seven gas-producers is to be held back temporarily, but the power station and the carbide factory are practically finished and production is expected to begin on February 1. Costs have been heavier than anticipated and the company is now offering to holders of ordinary and preference shares £75,000 eight per cent. first mortgage debenture stock, of which the directors and their friends will take £55,000, if necessary.

REPORTS OF NITRATE COMPANIES.—Five of the nitrate companies that closed their financial year on June 30 have issued their reports, which show that on the whole profits have been fairly well maintained. The following figures are taken from the *Financial Times* of November 23:—

Year ended June 30.	Profits.		Div.		Carry forward.	
	1921.	1920.	1921.	1920.	1921.	1920.
	£	£	%	%	£	£
Lagunas Synd. ..	15,100	16,600				
Liverpool Nitrate	113,800	127,000	100	140*	96,700	34,100
London Nitrate	22,600	10,200	7½	7½	20,700	13,200
Santa Catalina Nitrate	30,900	10,200	20	20	16,700	1,600
Santiago Nitrate	15,200	14,400	7½	7½	9,200	6,000

* Free of tax. † Including £10,000 added to reserve.

REVIEWS.

FORENSIC CHEMISTRY. By A. LUCAS. Pp. vii.+268. (London: Edward Arnold and Co. 1921.) Price 15s. net.

The author is to be congratulated on having written a book which supplies many of the deficiencies of the standard text-books on Forensic Medicine and Toxicology. The title of his book "Forensic Chemistry" is, however, somewhat misleading since it suggests that the work deals mainly with chemistry. In point of fact microscopy, physical investigations, and investigations requiring the use of common sense and general scientific knowledge, which one might describe under the terms of "Scientific Detective Investigations," occupy a large portion of the book. These are of especial value since many of them are not dealt with in any other book.

The introductory chapter contains some very sound advice to those engaged in the scientific investigation connected with legal cases, and lays stress upon the careful details as to the mode of work and recording of everything that is done so that precise details may be given in the witness box. The advice as to the giving of evidence is sound and is obviously based on practical personal experience.

One of the best chapters in the book is that on blood stains, and the author acknowledges the help received from Mr. W. M. Colles, of the Ministry of Justice, Cairo, who also collaborated in the chapter on poisons. The various tests described for blood and their details are of great practical value; many useful helps in technique are given, and there is a good account of the biological test together with the modifications which are found necessary in a tropical climate. The chapters on bullet and other projectiles for firearms, clothing, counterfeit coins, firearms, explosives and explosions all contain interesting and useful information. One of the most interesting chapters is that on documents, which records most valuable information concerning the detailed examination of the material of a document, the various kinds of ink, visible and invisible, and the changes which occur with age. The whole of this chapter shows that the writer is speaking from a very extensive practical experience.

The chapter on poisons is a brief one, since the author aims at avoiding repetition of material to be found in other books. It would perhaps be advisable if in a future edition this chapter were somewhat extended. The method advised of taking samples for analysis is scarcely applicable to this country, since it is stated that strong spirit, either plain or methylated, should be added as a preservative in every case. In a tropical country this may be necessary, but in temperate countries it is most desirable that no preservative of any kind be added to viscera which are to be analysed for poison; there is always risk of the preservative containing poisonous substances, and the difficulties of analysis may be much increased in this way. It is stated that a generous supply of viscera should be sent for analysis in fatal cases and the quantities required of liver, kidney and intestines are given. In cases of suspected fatal poisoning it is most desirable that *all* the viscera be sent for analysis, since by this means a much more accurate estimation of the total amount of poison present in the body can be obtained. There is no mention made of the necessity for taking portions of the hair, nails, and muscle in arsenical poisoning. In cases where the question of acute or chronic poisoning by arsenic may arise, it is necessary that an analyst should be furnished with these materials. In the case of veronal poisoning further details might with advantage be given as to the methods of isolating and purifying this substance.

An interesting chapter is given on preservation of the human body, and this is based on a number of original observations made on dead bodies in Egypt at various periods after death.

This book on forensic chemistry forms a really valuable addition to the existing text-books on medico-legal investigations, and everyone engaged in that kind of work will be wise in providing himself with a copy. The volume should find a place in every scientific library and analytical laboratory.

W. H. WILLCOX.

THE SILVER BROMIDE GRAIN OF PHOTOGRAPHIC EMULSIONS. By A. P. H. TRIVELLI and S. E. SHEPPARD. *Monographs on the Theory of Photography from the Research Laboratory of the Eastman Kodak Co.* Edited by C. E. K. MEES and M. S. SCHIRAMON. Pp. 143. (New York: D. Van Nostrand Co. 1921.)

More than twenty years have elapsed since it was first noticed that the fundamental units of photographic "emulsions" are small grains of silver halide embedded in the gelatin of the film, and during this period much research work has been done to discover more about these grains. It is therefore somewhat surprising that this monograph, the first of a series on the theory of photography, is the first book on this subject in the English language. Although it is intended to cover the whole of the literature of the subject—and to aid in this purpose numerous references are given and a complete bibliography appended—the greater part deals with original work carried out in the Kodak laboratories and not previously published.

In the early chapters factors determining the "ripening" of emulsions are considered. A new theory is put forward to explain the so-called "ammonia development" of exposed plates; the authors have shown that this is a development not of the latent, but of the visible image, produced by the recrystallisation of silver halide-ammonia compounds on nuclei furnished by the exposure.

The bearing of von Weimarn's theory of precipitation on the dispersity of silver precipitates is then considered. One would have expected that the authors would have given a more lucid account of the theory; they give the average reader credit for a better knowledge of this than he might be expected to have, and matters are not simplified by the rash manner in which symbols are employed without definite indication of their significance. However, in spite of this, in the chapters dealing with the application of von Weimarn's work to the more complicated processes of ripening in the presence of colloids, solubilising agents and other additions, the theory is applied in an exceedingly interesting manner, and leads naturally to the consideration of the phenomena of crystallisation and of the forms of the crystals finally resulting. The catalysis of crystallisation and the effect of capillarity on crystal growth receive attention, the latter having been extensively investigated both theoretically and practically.

The second portion of the book deals with the experimental study of the crystallisation of silver bromide, and this section of the work is considerably less involved and more likely to appeal to the practical man. It is illustrated with reproductions of a large number of photomicrographs, both of actual photographic emulsions and of silver-bromide crystals grown under carefully controlled conditions. Many of these exhibit the most diverse forms, and some, notably those taken with polarised light, are excellent examples of photomicrographic work of a high order. For an exhaustive investigation of the crystallography of silver bromide the specially grown crystals were used, and the directions of most rapid growth of the crystals determined, an explanation thus being afforded of the

various kinds of the crystal which occur in the emulsions of commerce.

The monograph concludes with a consideration of the use of polarised light in the investigations and a summary of the results of crystallographic study. Although in places there is a notable lack of the lucidity desirable in the treatment of somewhat involved theories, on the whole the arrangement is good and the work should serve admirably the purpose for which it is intended.

G. I. HIGSON.

THE ANALYSIS OF COAL AND ITS BY-PRODUCTS. By S. ROY ILLINGWORTH, assisted by J. GRIFFITHS. Pp. 380, with 63 figs. in text. (London: The Colliery Guardian Co., Ltd. 1921.) Price 21s.

The publication recently of several books dealing with the analysis of coal and its by-products is a healthy symptom of awakened interest in the subject of the scientific use of coal. No better exponent of the subject could be desired than Mr. Illingworth, whose scientific work on the carbonisation of coal is well known and admired and whose practical experience is wide. The latter fact becomes self-evident from a perusal of the work now under review, wherein are described, with a wealth of practical detail, those methods of analysis and examination of coal which, presumably, its author has found most reliable. Many of the details of the methods described with such care have been worked out by the author, who has also devised apparatus which enables results of such routine determinations as "moisture" and "ash" in coal, to be obtained rapidly and with sufficient accuracy.

Alternative methods of analysis are frequently given. In this connexion it is, perhaps, unfortunate that the reader should sometimes be left in doubt as to which method the author regards as the more satisfactory. However, if such vagueness stimulates analysts to make investigations for themselves (and to place the results on record) rather than blindly to follow Mr. Illingworth's advice, it will help to realise the ambition expressed in his preface that the methods described should "furnish a nucleus around which there is subsequently crystallised a more scientific control of the winning, sale and use of coal and its products."

As already indicated, a striking feature of the book, and that which must render it a boon to the busy analyst and a godsend to the lazy-minded, is the care and clarity with which even the simplest operations are described. For this reason occasional lapses are the more noticeable; for example, the estimation of moisture in coal is recommended to be made in a copper-jacketed water-oven fitted for use under a vacuum (p. 15), but when the method is described (p. 16) it is not stated whether a vacuum is, in fact, to be used or whether a current of air is to be created, as when mine dusts are analysed (p. 359); incidentally, information as to how to render the door of this oven airtight would be welcome. There are a few similar deficiencies, but the only inaccurate statement, apart from obvious misprints, noticed is that regarding the estimation of benzene and olefines in gas analysis (p. 268), which recommends the use of fuming instead of ordinary sulphuric acid (sp. gr. 1.81) as an absorbent for benzene vapour.

As well as descriptions of analytical methods, the book contains a chapter (Chapter I.) on the sampling of coal, the importance of which is rightly emphasised; and one (Chapter XV.) on the resolution of coal into various components by means of solvents—a subject of which Mr. Illingworth has made a special study; altogether it is a valuable addition to the literature of fuel. It has the merit, also, of being well printed and produced.

R. V. WHEELER.

OBITUARY.

H. INGLE.

Dr. Harry Ingle, who died on December 4, 1921, was educated at the Leeds Middle Class School, and at the Yorkshire College where he graduated with first-class honours in chemistry and gained the Le Blanc medal for technical chemistry. He was the first Doctor of Science of Leeds University and the first graduate of that University to obtain an 1851 Exhibition Scholarship, with the aid of which he studied under von Bayer and Thiele in Munich. Returning to this country with the degree of Ph.D., he served successively as honorary demonstrator in organic chemistry in the University of Leeds and head of the chemical department in the Technical School, Hull. His next post was chemist to Messrs. Barry Ostlere and Co., linoleum manufacturers, of Kirkealdy, and latterly he carried on a consulting practice in Leeds.

Ingle contributed eleven communications to this Society, of which five were read before the Scottish Section (1902-08), and six to the Yorkshire Section (1912-19); the majority of these related to the chemistry of oils, and in particular to their oxidation. He was a regular attendant at the meetings of the Yorkshire Section and served upon its committee from 1917 to 1919.

PUBLICATIONS RECEIVED.

THE MANUFACTURE OF CANE SUGAR. By L. JONES and F. I. SCARD. Second edition, revised. Pp. 181. (London: Duckworth and Co. 1922.) Price 25s.

SOAPS AND PROTEINS: THEIR COLLOID CHEMISTRY IN THEORY AND PRACTICE. By DR. M. H. FISCHER, with Drs. G. D. McLAUGHLIN and M. A. HOOKER. Pp. 272. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1921.) Price 24s.

DIE METHODEN DER ORGANISCHEN CHEMIE (WEYL'S METHODEN). General Part. Vol. I. Edited by Prof. J. HUGGEN and associates. Second revised and enlarged edition. Pp. 1121. (Leipzig: Georg Thieme. 1921.) Price, paper, 700 mk., bound 800 mk.

NACHWEIS, ISOLIERUNG, ABBAU- UND AUFBAUSTUDIEN AUF DEM GEBIETE DER GERBSTOFFE. By K. FREUDENBERG. ISOLIERUNG, NACHWEIS UND ABBAUSTUDIEN AUF DEM GEBIETE DER GERBSTOFFE. By E. SIEBURG. *Handbuch der Biologischen Arbeitsmethoden.* Edited by Prof. E. ABDERHALDEN. Section I. *Chemische Methoden.* Pt. 10, Vol. II. Pp. 439-584. (Vienna: Urban und Schwarzenberg. 1921.) Price, paper, 78 marks.

BULLETIN OF THE IMPERIAL INSTITUTE. Vol. XIV., No. 3, 1921. Pp. 271-416. (London: John Murray. 1921.) Price 3s. 6d.

THE PRODUCTION OF COAL AND COKE IN CANADA DURING 1920. *Canada Department of Mines. Mines Branch.* Pp. 36. (Ottawa: F. A. Acland. 1921.)

PUBLICATIONS OF THE MINES BRANCH, CANADA. *Department of Mines.* (Ottawa: Government Printing Bureau. 1921):—

THE PREPARATION, TRANSPORTATION, AND COMBUSTION OF POWDERED COAL. By J. BLIZARD.

GAS-PRODUCER TRIALS WITH ALBERTA COALS. By J. BLIZARD and E. S. MALLOCH.

CHEMICAL WARFARE AND THE WASHINGTON CONFERENCE.

SIR EDWARD THORPE.

The resolution adopted with unanimity at the recent Washington Conference by the representatives of Great Britain, France, Italy, Japan, and the United States—in other words, by all the Powers of which it was comprised—reaffirming their adhesion to the Article in the Hague Convention banning the use of “asphyxiating or deleterious gases” in warfare is of such supreme importance to humanity that it deserves the widest possible publicity and may fittingly be recorded in the pages of this Journal. It reads as follows:—

“The use in war of asphyxiating, poisonous or other gases and all analogous liquids, materials or devices having been justly condemned by the general opinion of the civilised world and a prohibition of such use having been declared in treaties to which a majority of the civilised Powers are parties;

“Now to the end that this prohibition shall be universally accepted as a part of international law binding alike the conscience and practice of nations, the signatory Powers declare their assent to such prohibition, agree to be bound thereby between themselves and invite all other civilised nations to adhere thereto.”

The immediate value of this pronouncement is immense; its prospective and potential value is incalculable. Immediately, it means that five of the leading and most powerful nations of the world are back to the position they were in under the Hague Convention. At least among themselves they say they will have nothing more to do with the departure from the recognised rules of war initiated by the Germans at the battle of Ypres. But this is not all. They are pledged to invite all other civilised nations to follow their example. Is it to be supposed that the moral force behind this resolution is impotent? On the contrary. The example set by the signatories—representatives of five Powers made still more powerful by the fortune and arbitrament of the greatest of all wars—is bound to exercise a profound influence upon the policy and action of other nations. It is sanctioned and strengthened by the dictates of a common humanity and has behind it the impulsive force of the conscience of the world. We may, therefore, in effect, substitute “induce” for “invite” in the resolution, for it is reasonably certain that if the Powers named combine and take collective action to bring their prestige and influence to bear, their example would be willingly and promptly followed. The chorus of approval which greeted the action of the Conference has found an echo in the Press of every country, and is significant of the universal feeling of the world. Senator Root, when presenting the brief treaty, embodying the resolution above-quoted, to the assembly in the Memorial Hall at Washington, surely never enjoyed a greater personal triumph than in the enthusiasm with which the crowded galleries acclaimed his conviction that this treaty “crystallised in simple and unmistakable terms the opinion of civilisation.” There were cynics, he said, who might deny its value—Gallios who declared that under the stress of war it would never be observed—but he reminded them of a force greater than Governments, the force of the public opinion of the civilised world which if outraged could mete out terrible punishment.

This wave of sentiment now rolling round the world is too deep-seated to be spent in froth. Interested persons whose occupation is war, and who are inclined to regard chemical warfare as a

legitimate development of an age of science, may seek to belittle its force. Apathy and prejudice may even ignore its existence. “Experts” may declare that it is impossible to control the manufacture of poison gas as a military agency. “Impossible,” said Napoleon, “is a word to be found only in the dictionary of fools.” The problem is not insoluble; there are already agencies at work which are bent on solving it, and with the sympathy, resolution, and co-operation of a world determined upon destroying “a weapon of war which has won such universal execration,” it will be solved. Germany, we recognise, is the outstanding menace—the *fons et origo* of the whole disgraceful business. What is to be her attitude to it in the future? She has on more than one occasion sought to excuse herself for initiating it, and there is a strong body of opinion in Germany that has condemned it. The efforts of those who have striven to exculpate her have not raised her in the respect of the world.

“ Oftentimes, excusing of a fault
Doth make the fault the worse by the excuse.”

Those of her subjects who are not blinded by passion, or obsessed by the desire for revenge, must recognise how much she has suffered under the moral condemnation of the world for her treacherous breach of the undertaking she gave under the Hague Convention to which she was a signatory. With the disappearance of the Hohenzollerns, to whom international obligations were never sacred when it suited their policy to disregard them, and under the chastening influence of the *débâcle* she has brought upon herself, we may hope that another spirit may arise in Germany. If she, too, announced her willingness to accept the invitation of the five Powers to conform to the letter and spirit of the Hague Convention in this matter of poison-gas, giving a binding assurance of her good faith, what we call chemical warfare would be a thing of the past among all nations that have any feeling or regard for the true spirit of civilisation.

If Germany wishes to secure the esteem and regard of her late enemies who desire to re-establish good relations with her she will hasten to conform to the general sentiment. She cannot be insensible to the moral effect of the work of the Washington Conference, or of the relief it has brought to a war-weary world which has suffered so much from the curse of an aggressive militarism. Esteem and regard are based upon trust and confidence, and these upon integrity and righteous dealing: together they are at the basis of international comity. International comity is and must be at the basis of commerce—whatever a cynical selfishness may say to the contrary. Germany is essentially a trading community; no people are more keenly alive to the material benefits of commerce. A primary condition of a world-wide commerce is the good opinion of the world.

Professor Haber has recently assured us that from his knowledge of the development and course of chemical warfare he is able to state that, although he himself was at work on lethal substances, as a means of offence in war, in the laboratory of the Kaiser Wilhelm Institut für Physikalische Chemie, of which he is the Director, in the first month of the war, he never met anybody connected with the army, who, previous to the war or during the first two months of its course, had conceived the idea of providing the field army with gas, or had made experiments or preparations for such a purpose; and that the military officers in Headquarters' motors who visited his institution in August, 1914, came for quite other purposes than to acquaint themselves with the results of his trials. As he states, Professor Haber, from his acquaintance with every man of any importance in the Army, was

doubtless in a position to be well informed. But what are we to infer from this? That the idea of using poison-gas did not originate with the military authorities? With whom, then, did it originate? With those who directed the Rhineland Chemical Establishments? If so, Dr. Duisberg and his colleagues of the Interessengemeinschaft rest under a very heavy implication. If the responsibility is theirs they have smirched the fair fame of German chemical industry with an indelible stain.

Although the action of the Washington Conference is eminently satisfactory and of great encouragement, it is obvious that much remains to be done before the consummation so devoutly to be wished is attained. Public opinion requires to be organised, for official action seldom moves in advance of it. The machinery for this action exists in the League of Nations, and every effort should be made to set it in motion. Organisations in this country are already at work to this end, and the co-operation of similar agencies in other countries should be sought. Prompt, collective, and harmonious effort will ensure success.

THE SAFEGUARDING OF INDUSTRIES ACT.

CALCIUM CARBIDE.

The complaint that calcium carbide was improperly excluded by the Board of Trade from the list of articles subject to import duty under Part I. of the Safeguarding of Industries Act was heard by the Official Referee, Mr. Cyril Atkinson, on December 10, 17, 21, and January 11, 19, 20, 21, and 23. The complainants, the British Cellulose and Chemical Manufacturing Co., Ltd., and British Carbide Factories, Ltd., were represented by Sir Arthur Colefax and Mr. J. Hunter Gray. The opponents were Allen-Liversidge, Ltd., the British Acetylene and Welding Association, and others, represented by Sir Duncan Kerly and Mr. C. Terrell; the Acetylene Corporation of Great Britain, and certain Norwegian and Swedish interests, represented by Mr. Douglas Hogg and the Hon. R. S. Cripps. Mr. Whitehead and Mr. Trevors Watson were counsel for the Board of Trade.

On the economic side, evidence was given for the complainants by Mr. J. Rogers, technical manager of Nobel Industries, Ltd., by Mr. M. B. Dickie, general manager of the British Cellulose Co., and by Mr. S. E. Artiss, secretary of British Carbide Factories, Ltd.; and for the opponents by Mr. I. Hoy, managing director of carbide factories at Kopervaaen, Norway.

It was contended that carbide manufacture is a key industry inasmuch as it is needed for the production of acetylene, used in welding and in certain organic syntheses. Recent importations have been:—66,825 cwt., worth £58,386, in September, and 37,825 cwt., valued at £33,683, in October. During the war the British Cellulose Co. was asked to erect, and did erect, a plant costing £600,000 with a capacity of 120 tons per day, the average daily output before it was closed down in 1920 being 30 tons. At that time the wholesale selling price was £26 per ton and the cost of production nearly £33, or £7 below that which was required to keep the plant working. To-day, owing to reduced cost of labour, materials, etc., a much lower price is required, and—Mr. Dickie stated—the cost of production in England would probably not be greater than the cost abroad. Asked by the Referee why help was required, Mr. Dickie replied that carbide-

manufacture was a "key" industry; the Government had insisted on the erection of the plant, and had not contributed towards its cost; assistance was required to spread the charges over the whole works; and it would provide employment.

Manufacture has now ceased in Norway, Sweden, and Switzerland, and Germany, Austria, and Czechoslovakia are supplying the world's markets mainly from existing stocks. According to Mr. Hoy, this country cannot compete with Norway owing to the difference in cost of power, £6 per ton of carbide, from coal, in England, against £1 10s. per ton, using water power, in Norway. Both the anthracite and the tinplate (for packing) used in Norway are obtained from South Wales, and the imposition of an import tax would merely raise the price of carbide in this country. If supplies were brought from Canada instead of from Norway, we should lose our market for anthracite and tinplate.

British Carbide Factories, Ltd. was also asked to increase production during the war; its plant cost £40,000 and had an output capacity of 5000 t. a year. The factory at Manchester, which was removed from Thornhill in 1916, has been closed down since Easter, 1921 (*cf. J.*, 1918, 85 n).

Scientific evidence was given for the complainants by Mr. Horatio Ballantyne, Prof. W. H. Perkin, Prof. G. T. Morgan, and Prof. J. T. Hewitt; and for the opponents by Mr. J. Swinburne, Dr. M. O. Forster, Dr. W. R. Ormandy, Capt. A. C. G. Egerton, and Mr. C. A. Hill. Complainants' case was that calcium carbide is a synthetic organic chemical, and therefore it should be put in the list of dutiable articles.

The meaning of the term "chemical" was admitted by both sides to be of minor importance, and not much emphasis was laid upon the precise signification of the word "synthetic." In the complainants' view everything depended upon the interpretation of the word "organic"; and Mr. Whitehead stated that carbide had been omitted from the list because in the opinion of the Board of Trade it was not organic. There was much discussion concerning the following definitions of organic chemistry:—

(1) Organic chemistry is the chemistry of the compounds of carbon.

Witnesses for the complainants were satisfied with this definition, but for practical reasons regarded carbonates as an exception; Prof. Perkin, however, thought that they should be included. The opponents' witnesses admitted the definition but also excluded all carbides.

(2) Organic chemistry is the chemistry of the hydrocarbons and their derivatives.

The inclusion or exclusion of calcium carbide obviously depends upon the meaning of the word "derivative."

Mr. Ballantyne and Prof. Morgan having accepted definition (1) as the wider academic definition then considered carbides from the standpoint of (2). They held that some carbides were organic in the narrower sense, *e.g.*, calcium and aluminium carbides, because they were the source of acetylene and methane, respectively, and some were inorganic, *e.g.*, carborundum was not structurally related to any hydrocarbon.

According to Prof. Perkin, calcium carbide was a derivative of acetylene because it could be produced from acetylene; in most cases to which the term was applicable the action was reciprocal, *i.e.*, if B was obtainable from A, A was obtainable from B, and the conversion might be direct or indirect. Water was not a derivative of acetylene, because when acetylene was burnt it was destroyed in the process. Similarly carbon dioxide and water were not derivatives of benzene, because the hydrocarbon could not be recovered from them; but sodium acetate was a derivative of acetic acid. In Prof.

Morgan's view the concept "derivative" mainly implied structure, and calcium carbide was not only a source of acetylene but had the same molecular structure. Prof. Hewitt also held that the term connoted conservation of the molecular structure when individual atoms or radicals were replaced by chemical action.

Dr. Forster did not regard calcium carbide as a derivative of acetylene, because there was no evidence that they had the same molecular structure; the structural formula usually ascribed to carbide was based upon its reaction with water; but its properties were quite unlike those of acetylene, and it was against all experience to call it a cyclic compound because no admittedly cyclic compound contained a triple-linked carbon atom. True acetylides, like copper and silver acetylides, differed widely, both in method of preparation and in properties from carbides such as calcium carbide and silver carbide, and their structural formulae were probably similar to that of acetylene, i.e., they contained two triple-linked carbon atoms. Dr. Forster preferred to regard the molecule of calcium carbide as composed of an assemblage of C—Ca—C groups linked together by means of the residual affinity of the whole group, and stated that there was no evidence whatever that CaC_2 was a molecular formula. In many reactions the carbon in calcium carbide behaved as if it were present in single atoms, e.g., in the reactions with steam, nitrogen, ammonia, fused potassium thiocyanate, bromine (at 100°C .), and sulphur, but the reactions with water, bromine (cold), iodine, and methyl alcohol were more in harmony with the complainants' view. In answer to the Referee, Dr. Forster said that if it were shown that calcium carbide contained triple-linked carbon atoms, he would regard it as a synthetic organic chemical. Before this case arose, probably no one had ever troubled to inquire if calcium carbide was organic or inorganic, and he had certainly never heard any chemist refer to it as an organic substance.

Dr. W. R. Ormandy refuted the proposition that because a substance was obtainable from acetylene, therefore it was an acetylide; quite a number of carbides that gave acetylene were more readily made from carbon dioxide. True acetylides were insoluble in, but stable towards water; they had not been obtained as large crystals, but were microcrystalline. Calcium carbide was a solid crystalline substance which, owing to its insolubility, etc., was unamenable to molecular-weight determinations; its molecular structure, if it had a molecule at all, was purely a matter of guesswork; and even were it proved to contain two treble-linked carbon atoms, he would still, having regard to all the circumstances, classify it as an inorganic substance. Rigid definition was impossible; (2) was a reasonably accurate academic definition or description, but there were exceptions to it.

The following definitions were also mentioned:—(3) An organic compound contains a carbon atom united with another carbon atom, or an atom of hydrogen or nitrogen. (4) An organic compound contains a carbon atom which is united with at least one atom of hydrogen (Emil Fischer). Both of these would exclude calcium carbide from the ranks of organic compounds.

There was also much discussion as to the relative importance of the constituents of calcium carbide. Witnesses for complainants said that carbon was the more important because it conditioned the formation of the valuable product acetylene. Opponents' witnesses maintained that it was the calcium because of its great affinity for oxygen; lime being a strongly exothermic compound and acetylene endothermic. This view was emphasised by Dr. Ormandy by reference to the carbides of cerium, which with water give different hydro-

carbons according to the amount of oxygen with which the cerium combines, so that the nature of the hydrocarbon produced appears to depend, not on the molecular structure, if any, of the carbide, but upon the number of different oxides the metal forms.

The case for the opponents was based mainly upon the contention that the organic nature of a substance can be determined from the collective results of certain qualitative tests mentioned in the textbooks.

(a) When heated to about 300°C . organic substances undergo change and usually char.

Various exceptions to this statement were pointed out. In the earlier stages of the hearing it was generally accepted that calcium oxalate and calcium carbide are exceptions, but later the former was shown to turn gray on heating, and commercial carbide to char with facility when heated at 500°C ., and even at somewhat lower temperatures. It was also shown that calcium carbide turns black when treated with ordinary concentrated sulphuric acid. Prof. Morgan stated in his evidence-in-chief that carbide charred on heating with nitrogen when carbon was eliminated with formation of calcium cyanamide.

(b) Organic substances are generally unstable, particularly towards heat.

Calcium carbide is a furnace-product, produced at 1600° – 3000°C ., and in this respect is unlike any admittedly organic substance.

(c) Organic substances dissolve in appropriate solvents.

Calcium carbide is insoluble in all solvents, and it cannot be purified by crystallisation, precipitation, distillation, or sublimation.

(d) Organic compounds are relatively soft.

Calcium carbide is hard (4 on the Mohr-scale in one direction and 6 in another), and Dr. Ormandy stated that he knew of no organic substance, including Baekelite products and lead glycerate, which had a hardness greater than 3.

(e) Organic substances have not the stony, heavy, mineral-like character or the very high melting-point of calcium carbide.

Much time was devoted to references to chemical literature, from which it appears that calcium carbide is almost always mentioned in both organic and inorganic text-books, although it is treated in detail in the latter. Newth's "Inorganic Chemistry" is the only text-book which definitely states that calcium carbide is not an organic chemical; and Richter's "Organic Chemistry" classifies it among the acetylides. Transactions and Abstracts include it in either category. Patent-Office publications, Swiss, Italian and United States' tariff lists classify it as inorganic.

At the conclusion of the evidence, Mr. Whitehead submitted that there was no crucial test to distinguish organic from inorganic substances, and therefore the Referee must consider whether the expression "synthetic organic chemical" as a whole had not some significance beyond that arrived at as a result of dissecting it. The ordinary meaning of the expression was something which had a relation to a substance found in nature, of which the preparation was undertaken in many cases either to test it or to throw light upon its structure. On this interpretation, he maintained that the Board of Trade was right in having excluded calcium carbide from the list. The onus was upon the complainants to establish their case that the Board had made a mistake.

Mr. Terrell submitted that it was unnecessary to find any definition of the term before applying it, and that the discussion concerning molecular structure and the relative importance of the carbon in calcium carbide was irrelevant. The academic view must be discarded and that of the industrialist

alone considered; the method of manufacture must be the chief criterion, and that was all in favour of the view that calcium carbide was not a synthetic organic chemical; complainants had not shown that industrialists regarded it as such.

Mr. Hogg submitted that synthetic organic chemicals were included in fine chemicals, and calcium carbide was not a fine chemical. The Act was not addressed to skilled chemists but to those connected with trade; it had to be construed in a commercial sense, and the academic point of view should be excluded. It was impossible to arrive at a satisfactory definition of "organic": the fact that there were four definitions showed there was none; if there were one, there could not be four which were mutually exclusive. The division was really one of convenience, and all that could be done was to attempt to frame a working description. The fact that witnesses did not agree upon the classification of calcium carbide as a chain or a ring compound showed that nobody had thought of classifying it at all, for the simple reason that nobody had ever regarded it as an organic chemical. When witnesses had differed as they had done, how was the Referee to decide? The word "organic" in the Schedule applied to the fine-chemical trade and was never intended to apply to a product like calcium carbide, which was produced in tons at a very high temperature and without skilled supervision.

Sir A. Colefax denied that it had been suggested that calcium carbide was a fine chemical. There was no evidence that the term "synthetic organic chemical" had any industrial meaning at the date the Act was passed. The Act was not addressed to this man or that man but to the Board of Trade, who interpreted it with the aid of scientific people, and therefore the term was not a trade term. The first elementary rule of construction was that words and phrases of technical legislation were used in their technical meaning, if they had one, and otherwise in their ordinary meaning. The word "organic" was obviously a technical word for chemists. The Referee should first decide if calcium carbide was an acetylide, i.e., if it contained two treble-linked carbon atoms, and he submitted that that was the accepted view of its constitution at the date of the Act. He did not attach much importance to tests, but if it were established that calcium carbide was an acetylide it could not be other than organic, as Dr. Forster had admitted.

On February 6 Mr. Cyril Atkinson gave his decision, as follows:—

It is quite understood that what I am going to say is not my formal award, so that any rights which anybody had under Section 19 of the Arbitration Act remain. In this case the complainants contend that calcium carbide has been improperly excluded from the list of dutiable articles under the Safeguarding of Industries Act. It is said that it should have been included as a synthetic organic chemical. The question for me is whether calcium carbide is or is not a synthetic organic chemical within the meaning of the Act. I think I must hold first that all articles not dutiable under other Acts of Parliament are *prima facie* entitled to be imported into this country free of duty; second, that no article should be included in the list of dutiable articles under this Act unless it is reasonably certain that it is covered by the words used in the Schedule, if there is any reasonable doubt the substance ought to be excluded; and, third, that the burden of proof is on the complainants. To succeed, therefore, the complainants must prove that beyond reasonable doubt calcium carbide is a synthetic organic chemical within the meaning of the Act.

The complainants contend that the words "synthetic organic chemical" have a technical meaning

and that they must be given that technical meaning. They rely on the rule laid down in Maxwell that phrases of technical legislation are used in their technical meaning if they have acquired one, otherwise in their ordinary meaning. The opponents contend that the words must be construed in their ordinary commercial meaning. In my opinion the rule quoted from Maxwell should be applied to the present case. If the words "synthetic organic chemical" have acquired a definite technical meaning it is my duty to give them that meaning; if not it is my duty to find out their ordinary meaning, if they have one. If they have no definite meaning, technical or ordinary, definable in such language as would yield a reasonably definite test for the determination of the question, the only remaining way appears to be to ask: Is calcium carbide regarded as a synthetic organic chemical by the general body of persons having the technical knowledge necessary to enable them to form an opinion?

Now have the words "synthetic organic chemical" or even "organic chemical" acquired a definite technical meaning? Is there any single scientific definition of an organic chemical generally accepted by scientific persons or a large majority of them? Five definitions have been advanced, four of them by the complainants. Mr. Ballantyne said that the academic definition was "compounds of carbon with certain exceptions." He used the curious expression that this was the best so far produced, but he also said that it ought to be excluded as the decisive test. He referred to the definition "hydrocarbons and their derivatives" as a proposed definition. Dr. Perkin was very emphatic that the expression meant compounds of carbons without any exceptions at all, and that this definition should be rigidly applied. Prof. Morgan asked if we had not thrown over this definition some days ago. His view was that the true definition was "hydrocarbons and their derivatives." Dr. Hewitt had been taught by Sir Edward Frankland that an organic chemical was one in which an atom of carbon was combined with hydrogen, nitrogen, or another carbon atom, but said that he himself thought that "hydrocarbons and their derivatives" was probably the best definition. Mr. Rogers thought that "compounds of carbon which contain an organic radical" was the true way of putting it. There are thus three if not four different views as to the technical meaning of "organic chemical" to be found in the evidence of the complainants. The same diversity of view is found in the text-books; for example, in Richter and in Perkin and Kipping one finds the academic definition "compounds of carbon" laid down and rigidly adhered to. In Meyer and Jacobson, Newth, and many others the definition given is "compounds of carbon with certain exceptions." In Schorlemmer's "Rise and Development of Organic Chemistry" there is a very interesting account of the different views held with reference to the precise meaning of an organic chemical. The discussion ends with the writer saying, "We define, therefore, that part of our science which is commonly called 'organic chemistry' as the chemistry of hydrocarbons and their derivatives." The writer adds that even this definition does not fix a sharp boundary line between organic and inorganic chemistry. I cannot help thinking that there is still a great deal of truth in what Gmelin said in 1817, that the difference between organic and inorganic compounds could be better felt than defined. Without referring in detail to other text-books, I think it fairly summarises the position to say that the evidence of the witnesses and of the text-books referred to during the hearing shows that there is no technical meaning of the words "organic chemical" which has been generally accepted by chemists. I am

satisfied that the following statement from Basset is well-founded: "There are quite a number of carbon compounds which it is difficult to classify logically as either organic or inorganic." I believe it is this difficulty and the differing opinions held as to the compounds referred to which have prevented a general acceptance of any reasonably precise definition. As to the ordinary commercial interpretation of the term "organic chemical," no satisfactory evidence has been tendered.

I have, therefore, to take the last alternative test and ask whether it has been proved that calcium carbide is or has been regarded as a synthetic organic chemical by the general body of chemists, that is, by the general body of persons having the technical knowledge necessary to enable them to form an opinion. Even if I accepted the definition most generally given, namely, compounds of carbon with some exceptions, I should still be faced with the same question. The available evidence is of three kinds: There is the evidence of the witnesses called, there is the evidence of the text-books, and there is the evidence derived from other literature. First as to the witnesses. On the one side I have five able men well-qualified to speak who say that they regard calcium carbide as an organic chemical. On the other hand I have five equally able men who say just the opposite. Of the five witnesses called by the complainants four of them approach the question from the definition point of view. They say "That is my definition, and, therefore, I say that calcium carbide is an organic chemical." Mr. Ballantyne clearly did not think that this was the right way in which to approach the question. His reason for saying that calcium carbide was an organic chemical was its instability under work-a-day conditions, its characteristic behaviour, and the fact that carbon is the characteristic part of the molecule. Still I do not know that the fact that the witnesses have different reasons for their convictions is very material, and I am quite satisfied that the evidence of those five witnesses establishes the fact that a large body of scientific opinion regards calcium carbide as an organic chemical. But the evidence on the other side is equally convincing and establishes the fact that there is also a large body of expert opinion which does not regard calcium carbide as an organic chemical. The same result is arrived at from an examination of text-books. The text-books test ought to be the test most in favour of the complainants, for one would naturally expect text-book writers to lean towards the academic point of view. The strongest statement in favour of the complainants is to be found in Richter, who says in terms that calcium carbide is organic; but he also says that carbon dioxide and carbon monoxide are organic, whereas it is conceded that they are not so regarded. He simply takes the academic definition and rigidly adheres to it. Perkin and Kipping adopt the same rigid view, but although they adopt the academic position it is noticeable that calcium carbide is dealt with in the inorganic volume, and that in the organic volume it is mentioned but once, and that in reference to the way in which acetylene is produced, and that while silver acetylido and copper acetylido and potassium acetylido are referred to there is no mention of calcium acetylido. On the other hand, in Meyer and Jacobson it is said that organic chemistry embraces all compounds of carbon except the simplest, namely, carbon dioxide and its two salts, carbon monoxide, and certain compounds which arise at very high temperatures, namely, carbides which are usually dealt with in the inorganic branch on the ground of suitability. There was some dispute as to the correct translation of the last word, but I see no reason for not accepting Dr. Forster's evidence which is supported by Muret-Sanders' Dictionary. Another writer of

authority, Newth, says in terms that calcium carbide is not regarded as belonging to the organic division. Moissan, in his book on inorganic chemistry, published in 1904, says, "The organic compounds are not stated in this treatise. You will not find here any other combination of carbon except the metallic carbides, carbonates, cyanides, cyanates, etc." Von Groth gives carbides as one of the groups of inorganic compounds. Moissan, in his book on the electric furnace, treats the products therein discussed, which included calcium carbide, in the inorganic branch. It is said that this is done merely for the sake of convenience. Why should it be more convenient to deal with calcium carbide as a compound of calcium rather than as a derivative of acetylene unless it is that writers know that their readers will naturally look in the inorganic volume for information about it? It is inconceivable to my mind that there should be a vast majority of writers treating calcium carbide as if it were an inorganic chemical, and that it should never occur to one of them to say: "You must not be misled by my treating calcium carbide as inorganic; it is only done for convenience; it is really organic." The more I think of it, and I have thought of it a good deal, the more weight do I find myself giving to the text-book evidence. I repeat that I cannot believe that writers should almost universally be discussing and treating calcium carbide as if it were inorganic unless they regarded it as inorganic or, at any rate, as probably inorganic. In addition to the evidence to be derived from text-books there are the Patent Office publications, there are the Swiss and Italian tariffs, and, for what it is worth, the view taken in the United States by the Treasury Department, and there is the classification in the Chemists' Year Book. In my opinion the classification in this book is very significant with regard to questions as to generally accepted views.

It is unnecessary to go into further detail. I think I have said enough to indicate the basis of my opinion, which is, that it has not been proved that calcium carbide is generally regarded as a synthetic organic chemical by the majority of chemists. It is quite clearly established that a large body of technical opinion takes the opposite view.

I have not dealt with the word "synthetic," but it is useful to point out that there does not seem to be unanimity as to the meaning even of this word. Sir Arthur Colefax, in his reply, laid great stress upon the fact that the structure of calcium carbide was generally regarded as that of acetylene, and that, therefore, it must be an organic chemical within the hydrocarbon definition. It seems to me that the force of that argument rests upon the acceptance of the definition. That definition cannot be put higher than that it is a suggested definition, and the author of it warns us that "even this definition does not fix a sharp boundary line between organic and inorganic chemistry." At any rate, that argument has not carried with it the general body of expert opinion.

I have come to the conclusion that it is not possible for me to say that I am satisfied that calcium carbide has been improperly excluded from the list. Indeed, I think it has been properly excluded, and, therefore, the complaint fails.

If, after consideration, anybody wants a case stated as to those principles I am quite willing to state one.

In the subsequent discussion the Referee stated that he proposed to adopt the same principles in arriving at a decision with regard to "Fine Chemicals." If there was a technical definition, he would accept it. If there was not he would adopt the rule: Has it been proved that in the opinion of the bulk of chemists this or that is a fine chemical?

Opposing counsel having agreed that any application to the Referee to state a case for the opinion of the Court should be made within three weeks, two days' notice being given to the opposite side, the Referee stated that he would sign and publish the award. Further, he would be willing to consider an application for costs, but at the moment he saw no reason to depart from his previous inclination not to award costs in actions of this kind.

DEFINITIONS FROM THE NOTTINGHAM SECTION.

The following definitions have been drafted by the committee (*cf.* J., 1922, 24R). Definitions [A], which were adopted by a majority of the committee, are founded on those supplied by Dr. J. B. Firth and Mr. H. D. Richmond; definitions [B], favoured by a minority, are those contributed by Dr. E. B. R. Prideaux, with slight modifications:—

[A] *Chemical*.—A chemical is a substance which in the pure state has a uniform, definite composition, and cannot be resolved into two or more substances except by undergoing change of identity.

A chemical from a technical standpoint is as defined above, with or without an admixture of other substances in quantities sufficiently small to be regarded as impurities, prepared by a process which either,

(1) Alters the composition of the material or materials used in its manufacture; (2) alters its physical form in such a way that the separation from other substances in the material or materials used in its manufacture is facilitated; (3) alters the composition of other substances existing in the material or materials used in its manufacture whereby their removal is facilitated, and which is neither used mainly as a food or drink nor for such properties as form, strength, or appearance, but which is used in the arts and manufactures for its inherent properties.

Fine Chemical.—A fine chemical is a chemical so purified that the substances left as impurities are so reduced in amount that their effect on all uses of the chemical in the arts and manufactures is negligible.

[B].—A pure chemical substance is an element or compound as defined in the text-books of chemistry, *i.e.*, a substance possessing definite physical properties and definite composition.

A chemical substance in general may be a mixture of pure chemical substances, and may also contain small quantities of substances of indefinite composition.

The use of a chemical substance must be mainly due to its inherent properties, and in particular to its power of entering into chemical reactions, and not to any arbitrary shape which it may be caused to assume in a manufactured article.

In the preparation of a chemical substance, either by synthesis or by separation from a naturally occurring product, the ordinary processes as described in chemical and technical text-books must be employed. Food and drinks which may fall under these definitions are specifically excluded.

The Board of Trade has received complaints that lactose "R," mucic acid and synthetic camphor have been improperly included in the list of articles dutiable under Part I. of the Act, and that synthetic resin and products thereof have been improperly excluded therefrom. A complaint has been received under Part II. that gold (brass) metal powders and aluminium powder made in Germany are being sold in this country at prices below the cost of manufacture here.

NEWS FROM THE SECTIONS.

AMERICA.

On January 15 about 250 members and guests attended the meeting held in Rumford Hall, Chemists' Club, New York, when the Perkin Medal was presented to Dr. William M. Burton, president of the Standard Oil Co. of Indiana.

Mr. S. R. Church, chairman of the American Section, presided, and in his opening remarks said that in selecting the medallist from a great industry that was outside the narrow classification of chemical industries, the Medal Committee had once more demonstrated a catholic consideration of the problem, "What constitutes a signal achievement in applied chemistry?" He did not know why the petroleum industry should be outside, unless it was that the greatest achievements of the petroleum chemist still lay ahead. Was it not possible that some day petroleum would rival coal tar as a source of synthetic organic compounds?

Mr. Church was followed by Dr. Ira Remsen, who having had Dr. Burton under him as a student at Johns Hopkins University, was able to speak at first hand of his work and of how he had become interested in the petroleum industry. Dr. Charles H. Herty then paid a tribute to the personal character of Dr. Burton, who was his fellow-student at the University.

The third speaker was Mr. Russell Wiles, patent lawyer of Chicago, who for many years has been closely associated with Dr. Burton in his work on oil-treatment processes. Mr. Wiles spoke on the relation of chemistry to future industrial development, of the organisation of the Standard Oil Co. of Indiana, and indicated some of the many difficulties which Dr. Burton had encountered and overcome. The Company has been amazingly successful in co-ordinating the scientific and the manufacturing sides of the business. *Its system is founded on the premise that a scientifically-trained man is a good man for any job; the scientific staff does not co-operate with the manufacturing staff—it has become the manufacturing staff.* Trained men are engaged for the laboratory, where they are made familiar with works' problems in general and with problems of some one department in particular. After leaving the laboratory the chemist is given a subordinate position in the works, in which he has to test on a practical scale any improvements that may fall within the sphere of his department. Having once become established in the works, it has been found that almost without exception the scientific man—engineer as well as chemist—becomes an excellent executive officer, and his promotion is rapid. The result is that the manufacturing department of the Standard Oil Co. not only maintains an excellent research department, but the whole manufacturing organisation from top to bottom is largely dominated and controlled by men of scientific training. The company is unique in this respect, and the tremendous success of its manufacturing department is very largely due to the organisation conceived and executed by Dr. Burton.

The medal was then presented to Dr. Burton by Dr. Charles F. Chandler, the senior past-president of the Society living in America, who said that Burton was appointed to the Standard Oil Co. of Indiana in 1890 as chemist, in 1895 he became general superintendent, in 1911 director, and in 1918 president. Dr. Chandler recalled a visit he and Dr. Burton had paid to Germany in 1895-96, when they succeeded in persuading the German authorities that the foul-smelling, sulphur-bearing petroleum from Ohio, Illinois and Indiana, was, after treatment by Frasch's copper-oxide process, quite equal to Pennsylvania oil, it having been

rumoured that the German Government was intending to prohibit the importation of the Ohio oil. Fifty years ago the wholesale price of refined burning oil was 25 cents per gallon and that of light oils (naphtha) 5 cents. Unscrupulous retailers bought both, and by mixing them facilitated "kerosene accidents"; but after the introduction of the internal-combustion engine and the automobile, the demands for gasoline far outstripped the supply, even with the added quantities condensed from natural gas. Burton promptly attacked the problem of increasing the supply by converting the heavy, high-boiling oils into gasoline, by distilling them under great pressure at a very high temperature. It really seemed an impossible problem on account of the danger of explosions, but Burton triumphed and his process (which also yields a valuable variety of asphalt) is now in general use.

In handing the medal, Dr. Chandler said,—"It gives me the greatest pleasure, as the representative of the affiliated chemical and electrochemical societies of America, to place in your hands this beautiful Perkin Medal as a token of the appreciation and affection of your fellow chemists." Dr. Burton expressed his sincere thanks to the awarding committee and to the societies they represent, and then gave an address on the early history of the "cracking" process. (*cf. i.*)

In closing the meeting, Mr. Church said that the occasion was an exceptional one in that all of the Society's past-presidents living in America were present, viz., Dr. Chandler, Prof. Remsen, Dr. W. H. Nicholls, and Dr. M. T. Bogert. Dr. Rutan had also intended to be present, but was prevented owing to illness.

NOTTINGHAM.

The third meeting of the session was held on January 25, when a paper entitled "Notes on Cotton Bleaching" was read by Messrs. S. R. Trotman and S. J. Pentecost.

Cotton goods which have apparently been perfectly bleached sometimes develop a yellow colour on storing. After enumerating some known and preventable causes of this deterioration, the authors gave evidence which proved that the trouble was often caused by waxy constituents which are very resistant to lye-boiling. The lime soaps of these waxes are best attacked by a warm sour which, according to the experience of one of the authors, reduces the mineral matter to 0.1 per cent. or less. Higgins showed that after this treatment a further quantity of wax can be extracted by organic solvents, e.g., benzene. Such solvents are successfully used for extracting the waxes in the first place, thus obviating the necessity for a lye-boil under pressure. The logical and chemically sound sequence of operations would be: first a warm sour, degreasing with benzene, and then boiling with soda ash at ordinary pressures. The authors strongly recommend the use of warm bleaches (e.g., 1 per cent. at 40° C.) and of liquors such as sodium hypochlorite, which penetrate the goods easily. The work is thus more quickly done and there is less danger of producing oxycellulose.

NEWCASTLE.

On January 25 Mr. E. V. Chambers read a paper on "Tar Distillation," in which he described very fully the different types of plant used for distilling tar, special prominence being given to the intermittent and continuous types of stills. Figures were adduced to show the differences between tars from horizontal and tars from vertical retorts, from coke-oven plants, water-gas tar and producer-gas tar, and tar produced by low-temperature carboni-

sation. Special attention was devoted to the subject of water content, and the author described a plant that he had designed for the continuous treatment of very watery tars, including Mond gas-tar.

In answer to questions put during the discussion, Mr. Chambers said that the emulsified water in certain tars could not be adequately removed by settling and that either distillation or centrifugal systems had to be employed; of these the former was the cheaper. He did not agree that continuous plant could only handle small quantities. Labour costs on continuous plant were smaller and the fuel consumption was at most 110 lb. of coke breeze per ton of tar distilled, and in some cases as low as 88 lb. In spite of many disadvantages, the pot still could be worked to give excellent results by those who had the necessary skill and experience.

BIRMINGHAM.

A paper on "Acceleration of the Vulcanisation Process," by Dr. D. F. Twiss, and Messrs. S. A. Brazier and F. Thomas, was read by the first-named at the meeting held on January 26, Dr. Brownson presiding.

From the examination of a number of dithiocarbamate accelerators of vulcanisation, the authors have deduced several characteristics typical of these accelerators. Thus, they yield vulcanised products of unusually high tensile strength; one sample withstood, without breaking, a stress equivalent to a breaking-load exceeding 3.4 kg. per sq. mm., calculated on the original dimensions of the test piece. Not only do they produce unusually great resistance to extension, relative to the extent of the chemical change and the alteration in tensile strength, but the rubber develops maximum tensile strength at an unusually low coefficient of vulcanisation. For the full exercise of accelerating power the presence of zinc oxide is necessary, even with the zinc dialkyldithiocarbamates, so that these salts cannot be the actual catalyst, which must consist of a decomposition product common to the zinc salts, the aminodialkyldithiocarbamates, and the corresponding thiouram disulphides. If only a small proportion of zinc oxide is used, the curve showing the alteration in extensibility tends to indicate an early maximum, and the peak in the tensile-strength curve lacks sharpness. This effect is probably due to the initial formation of a limited quantity of highly active sulphur, of which the supply becomes rapidly exhausted. It was also found that alkyldithiocarbamates and thiouram disulphides derived from primary amines are much less powerful than the corresponding derivatives of secondary amines.

In discussing the importance of organic accelerators, Mr. Brazier pointed out that they have the advantage, compared with inorganic accelerators, of being readily soluble in rubber, and of not affecting the characteristics of vulcanisation to the same extent.

CHEMICAL ENGINEERING GROUP AND GLASGOW SECTION.

A meeting of the Chemical Engineering Group, in conjunction with the Glasgow Section, was held in the Institution of Engineers and Shipbuilders on January 27. The chair was taken by Mr. J. Arthur Reavell, chairman of the Group, and a paper was read by Dr. W. R. Ormandy and Mr. E. C. Craven on "Potential Developments in Refrigeration."

Refrigeration machinery is divided into two classes—compression and absorption machines. Compression machines employ carbon dioxide, sulphur dioxide or ammonia gas, or the vapour of ethyl

chloride; absorption machines depend on the use of ammonia with water; but an objection to the latter process is the difficulty of dealing with the water which necessarily evaporates with ammonia. Carbon dioxide is not employed in naval work because the efficiency of the plant depends on a constant low temperature of the condenser water, and this efficiency is reduced in hot seas. Ammonia compression plants are also rejected by naval authorities since they usually leak; but ethyl chloride is employed, although there is danger of its vapour making an explosive mixture with air. Sulphur dioxide has largely gone out of use.

The present proposals depend upon the fact that solid ammonium nitrate absorbs ammonia to form one or more liquid compounds which evolve their ammonia when heated to 100° C. To prevent the formation of cellular layers which would retard the evolution of ammonia from the liquid, ammonium nitrate is mixed with kieselguhr in the ratio 3:2 by weight, and this enables the plant to be kept stationary. A 2-ton plant has been erected by the Seay Syndicate which produces 26 to 30 tons of ice per ton of coal. The container is made of aluminium sheeting, as iron is corroded by ammonium nitrate. With regard to the risk of fire when ethyl chloride is employed, it has been found by Henning that when methyl chloride is mixed with ethyl chloride in suitable proportion, the resulting liquid is not only non-inflammable but is itself a fire-extinguisher. Consequently cylinders of the liquid mixture stored on board ship may serve a double purpose.

ORIGIN OF THE PETROLEUM "CRACKING" PROCESS.*

W. M. BURTON.

The work done under my direction which has perhaps attracted the most attention was carried on principally in the laboratory and refinery of the Standard Oil Company at Whiting, Indiana, a suburb of Chicago, and consisted in devising ways and means for the practical conversion of high-boiling fractions of petroleum into low-boiling fractions in such a way as to ensure substantial yields of suitable products with a minimum loss and at a reasonable expense.

The problem became imperative with the advent of the internal-combustion engine about fifteen years ago. The most commonly-known example of such an engine is, of course, the automobile which, as constructed to-day, requires a fuel that evaporates at comparatively low temperatures, has a high heating value, burns without leaving objectionable residues, does not possess an objectionable odour, is low-priced, and can be produced in large quantities. Benzol, toluol, and alcohol are fairly well-suited for the purpose, but their cost and their small volume of production render them largely unavailable.

The low-boiling fractions of petroleum naturally came into use for this purpose, and up to about 1910 the supply of this fuel was sufficient to meet the demand. In fact, the automobile provided an outlet for the sale of these products, which, to some extent, had been a drug on the market in the oil world. The older refiners in the country will remember when these so-called naphtha products were thrown away and allowed to run down the

streams adjacent to the refineries, thereby causing a wilful waste and a fire menace to the surrounding neighbourhood.

Prior to 1910 the average yield of naphtha or gasoline products from crude oil in the United States was about 11 per cent., this yield representing only the amount of such products (of the quality desired at that time) normally present in the crude petroleum, their separation being secured by ordinary methods of distillation at atmospheric pressure; and, further, this small yield was sufficient to furnish all that was needed for gasoline stoves and other industrial purposes prior to the advent of the internal-combustion engine for transportation purposes.

When the automobile came into general use, however, it was perfectly clear that the normal yield of naphtha products suitable for fuel in self-propelled vehicles would not be nearly enough. At that time our refineries were selling about forty per cent. of the products of crude oil for use as fuel and for gas-making purposes in lieu of coal. The remaining sixty per cent. represented the normal yield of naphtha and gasoline, illuminating and lubricating oils.

The above-mentioned forty per cent. fuel and gas oil comprised fractions boiling between 225° C. and 375° C. These oils could, if necessary, be withdrawn from the market, and our problem was to convert them as far as possible into fractions boiling between 40° C. and 200° C., the product to be equal in quality to normal naphtha products and the yield and operating expense to be commercially practicable.

Our first experiments were directed towards making a suitable product by superheating the vapours of the high-boiling fractions, but without pressure, somewhat according to the practice observed in making "Pintsch" gas. We soon found, however, that this so-called "cracking" in the vapour phase required a temperature so high that the aliphatic hydrocarbons contained in the petroleum were largely converted into cyclic and aromatic bodies and fixed gases—unsuited for our purpose. The yield was poor and the quality most undesirable. Obviously our problem included the proposition of reducing the molecular weight without changing the general structure.

We next tried the use of various reagents and catalysts, such as aluminium chloride and ferric oxide. Anhydrous aluminium chloride, indeed, produced some rather remarkable results. The yield and quality of naphtha products were fairly satisfactory, but there was a substantial loss of oil in the operations and the first cost of the anhydrous aluminium chloride, as well as the difficulty in recovering it from the residues, rendered this plan unattractive.

Nearly thirty years ago Sir Boverton Redwood and Prof. (now Sir James) Dewar, in England, had patented a pressure-distilling process for the purpose of increasing the yield of kerosene oil from the residues of Russian crude petroleum, but it was never applied industrially. It had been known, therefore, for some years that distilling petroleum under pressure served to break down the high-boiling fractions into low-boiling fractions; but, as far as we could learn, no one had ever done it on the large scale, and, in fact, such a proposition could not commend itself to a practical refiner because of the obvious dangers from explosions and fires that would be present in handling large stills under such conditions.

But having tried everything else that suggested itself, we attacked the problem of distilling petroleum in considerable quantities (8000 to 12,000 gallons) under pressure of about five atmospheres. The first still we built was of a welded design and was planned to handle 100 gallons of the high-boil-

*Address delivered by the recipient of the Perkin Medal at the meeting of the American Section, January 13, 1922. (cf. p. 488 of this issue.)

ing fractions. Obviously, the raw material first to be tried consisted of the so-called fuel oil, or reduced crude, *i.e.*, the residue of crude oil after the more valuable products had been removed. We soon found that we could not work profitably with this product; when distilled with or without pressure it produced quantities of cake that deposited on the bottom of the still and caused a red-hot bottom that would not stand any rise in pressure. The next proposition comprised the use of high-boiling distillates from the crude petroleum, *viz.*, oils boiling at 225° C. and upwards. By using these oils as raw materials we secured our first encouraging results. We distilled these distillates under a pressure of about five atmospheres and were thereby able to keep down the temperature to a moderate figure, the cracking being done in the so-called liquid phase. By doing the work in this way we found to our intense gratification that the low-boiling fractions produced belonged mostly to the aliphatic or paraffin series, which were easily deodorised and finished into products suitable for sale. Further, the yield of saleable liquid was good and the production of fixed gases and coke was small.

Experimentally, therefore, our work was successful. But the big problem remained to be solved. Could we build large equipment that would, in a practical way, secure the desired results and at the same time be durable and reasonably free from the fire hazard that always attends operations in an oil refinery? Some of our practical men said we could, but more of them said we could not. In this case, however, the majority was overruled, and we immediately prepared plans and specifications for a still 8 ft. in diameter and 20 ft. long, built of 0.5-in. mild steel plate, which would hold 6000 gallons of raw material. It had a safety factor of 5, the working pressure being 100 lb. and the bursting pressure 500 lb.

The still was built and charged, with many misgivings on the part of the doubters, but with boldness and confidence exhibited by the rest of us. So soon as we had the still hot and pressure began to develop we encountered our first difficulty. The still was built in a workmanlike manner, and would have made a good steam boiler, but we found that rivets and seams which would not leak under steam pressure leaked badly under oil pressure. It was difficult to induce boilermakers to caulk the leaks while the still was hot and under pressure, but we found men bold enough to do it, and the first run was sufficiently encouraging to induce us to proceed further. But the leaks persisted until Nature came to our aid; the minute portions of oil in the leaks gradually carbonised, and the leaks closed without our aid.

The experiments with the large still confirmed our results with the small one, *viz.*, the yield of suitable gasoline fractions was good; the loss was trifling; the cost was reasonable; and with close caution and supervision the fire hazard was not excessive. Further, we were astonished to find that the residue remaining in the still contained substantial quantities of asphaltine actually created (from a distillate containing none of it) by distillation under pressure.

We learned early in the work that operating at moderate pressure required a substantial dephlegmating system that would return to the still fractions boiling too high for our purpose, and allow the others to pass on.

A suitable safety-valve that would operate properly with oil vapours at high temperatures had to be devised. After making a number of runs with our 8×20 ft. still, and in view of the fact that the demand for gasoline was increasing at a rapid rate, we asked for an appropriation of one million dollars to build sixty pressure-stills 8 ft. in diameter and 30 ft. long, each holding 8000 gallons of raw

material. It required considerable argument to convince any of our directors that such a revolutionary proposition could possibly be successful, but finally they voted in favour of it, and we went ahead.

It would require much time to give a full account of the minor difficulties that arose. We had solved the big points, but there were many smaller ones. For successful results we must operate with the oil at temperatures from 370° to 400° C. in the still. At 450° C. steel begins to lose its tensile strength and its capacity to withstand pressure. It is clear, therefore, that with this narrow margin great caution must be exercised to prevent overheating. The human element enters here, as it does in every feature of pressure-still operation, but we operated over eight years with hundreds of these stills in daily use and manufactured millions of barrels of gasoline by this method before we had a fatal accident.

From the humble beginning of the 100-gallon still in our experimental laboratory, the Standard Oil Company of Indiana has in operation to-day over 800 pressure-stills with a gross charging capacity of 8 million galls., and licensees under our patents are operating as many more, giving a daily production of 2 million galls. of gasoline out of about 12.5 million galls. total daily output in the United States and Canada.

This amount of gasoline makes possible the use of two millions of motor vehicles more than could otherwise have been supplied from a given consumption of crude petroleum, and as a corollary of that proposition, and assuming 20 per cent. of gasoline as a normal average yield from crude oil, the pressure-still process is conserving for future consumption an amount of crude oil nearly equal to 100 million barrels per year.

The consumption of gasoline by internal-combustion engines during the past decade has increased at a terrific rate. In 1910 the United States consumed approximately 700 million galls., and for 1920 the Bureau of Mines statistics show a total gasoline production of four billion six hundred million galls., of which 850 millions was made from natural gas, over three billion galls. made by straight crude-oil distillation, and 750 million galls. made by the "cracking" process. Further, statistics show that whereas the increase in crude-oil production during the past decade has been 142 per cent., the increase in gasoline production has been over 700 per cent.; and although some of this gasoline has been exported, the larger portion has been consumed by the ever-increasing number of automotive vehicles in this country.

The increase in production of crude oil has not been commensurate with the increased demand for its products, but the pressure-still process has, at least, filled part of the gap. Naturally, one is inclined to speculate on the adequacy of future supplies of these important commodities. One suggestion would be that some of the large amounts of oil now being used for fuel and gas-making purposes be replaced with coal, and substantial portions of the oil used for making gasoline, the coal consumption, in turn, to be replaced in part by the further development of hydro-electric power.

The American people are notoriously wasteful in the use of natural resources, with which they are so richly endowed. It is hoped that the work outlined above will be considered a slight contribution towards the curtailment of such waste.

It would be obviously unfair and unjust to close this paper without duly acknowledging the work done by my associates in successfully establishing the pressure-still process. Our patent attorneys, represented by Mr. Russell Wiles, contributed many useful and practical suggestions, and if it had not been for the invaluable assistance of Dr. R. E.

Humphries, Mr. E. M. Clark, and Mr. T. S. Cooke, and many others connected with the Standard Oil Company, of Indiana, satisfactory results would never have been secured.

STANDARDISATION OF JACKETED PANS.

The Sub-Committee appointed by the Joint Research Committee of the Association of British Chemical Manufacturers and the British Chemical Plant Manufacturers' Association to consider the standardisation of steam-jacketed pans, has devoted, in the first place, its attention to cast-iron pans, as these are in the most urgent need of standardisation. With the object of designing a standard pan of maximum efficiency in respect of heating surface, working capacity, and strength, a series of drawings showing various shapes and flanges was sent to chemical manufacturers; a précis of the replies was forwarded to the plant makers, and their approval of the settled designs solicited.

As a result of the inquiry it was agreed that the standard working capacity (i.e., the heating capacity) for the types of cast-iron and enamelled cast-iron pans selected should be calculated from the underside of the bolting-flange of the liner. The actual capacity is greater, e.g., the deep pan of 25 gallons has an actual capacity of 34 gallons; so that in future a manufacturer will know that he can work 25 gallons in a standard 25-gallon pan, and not about 18 gallons as hitherto.

After very careful examination the Committee has decided to adopt a two-radii pan. The metal being cast-iron, it was found impossible to stipulate one thickness; to surmount this difficulty, and also to allow for a higher working pressure, the Sub-Committee has laid down limits of thickness. For a working pressure of 35 lb. the thickness of the metal must be within the limits stated, but for a 40-lb. or 45-lb. working pressure the thickness must be the outside limit stated on the drawings.

The Committee has also considered the possibility of fitting wrought-metal linings to the jackets, but has come reluctantly to the conclusion that it would be impossible to design cast-iron jackets for all the sizes considered that could be fitted with such linings. It is suggested, however, that in the deep patterns up to and including the 100-gallon pan, the wrought-metal liner could replace that of cast iron. The cast-iron liners have been designed for enamelling, and the Committee draws attention to the thickening of the metal at the flanges. This is considered to be important, and calculations have been made to allow sufficient metal so as to ensure gradual radiation at the non-heated contact points. The edges have been rounded so that the inside edge can be well covered with enamel, which will then not flake off when a stirrer is used. The lugs for the feet have all been cast on to the jacket with a strengthening web, and the inlets and outlets have been made to conform with the sizes of the pans. It will be noticed that the water drain is in the centre of the bottom of the jacket and not at the side as hitherto; it is generally agreed that the latter practice is wrong. The steam distributor, which is not shown in the drawings, is best inserted at the bottom, where the steam space is greatest and where there is less risk of the liner expanding unevenly. Bosses are cast on the upper edge of the jacket for safety-valve and air blow-off. Should a chemical manufacturer desire the steam-inlet on the top, which in the opinion of the Committee is wrong, a baffle-plate must be inserted. These steam distributors or baffles have not been considered, as the Committee is of opinion that they do not require standardising. In every case the steam

space has been carefully calculated and graduated for a steam-inlet at the bottom of the pan, so that steam entering the jacket shall cause the rise of temperature to be as even as possible.

The Sub-Committee desires to draw special attention to the 75- and 100-gallon shallow pans. It has been ascertained that cast-iron and enamelled-iron are not always used for these large sizes, particularly for the 75-gallon size, and the Committee has therefore designed the 75-gallon lining to fit into the 100-gallon jacket, making only one jacket necessary for these two sizes. In this way it is hoped to dispense with the standardisation of another unit. Attention is also drawn to the fact that the 50-gallon shallow pan and the 100-, 150- and 200-gallon deep pans have all the same diameter of flange on the liner, so that the universal cover, which the Committee is now designing, will fit them all.

The Committee has also taken into consideration the fact that this deep type of pan would make an admirable still, and the Sub-Committee is to discuss the question of providing these pans with outlets so that they can be converted immediately into stills, or stills into pans, using the one standard cover.

The designs given in the report represent the results of the examination of a very large number; each one of them has been carefully investigated, calculations of strength have been considered, and, in the opinion of the Committee, the specifications proposed will ensure plant of maximum efficiency.

The Sub-Committee suggests the adoption of the following tests, and that a certificate embodying the results be issued with every pan:—

Cast-iron Steam-jacketed Pans.

A. For a working pressure of 35 lb. per square inch (shape as in drawings):—Thickness of metal to be within the limit stated on the drawings; hydraulic test, 75 lb. per sq. in.; steam test at working pressure for at least half-an-hour.

B. For working pressure of 40–45 lb. (shape as in drawings):—Thickness of metal to be the greater thickness stated on drawings; hydraulic test, 90 lb. per sq. in.; steam test, 45 lb. per sq. in. for half-an-hour.

Enamelled Cast-iron Standard Steam-jacketed Pans.

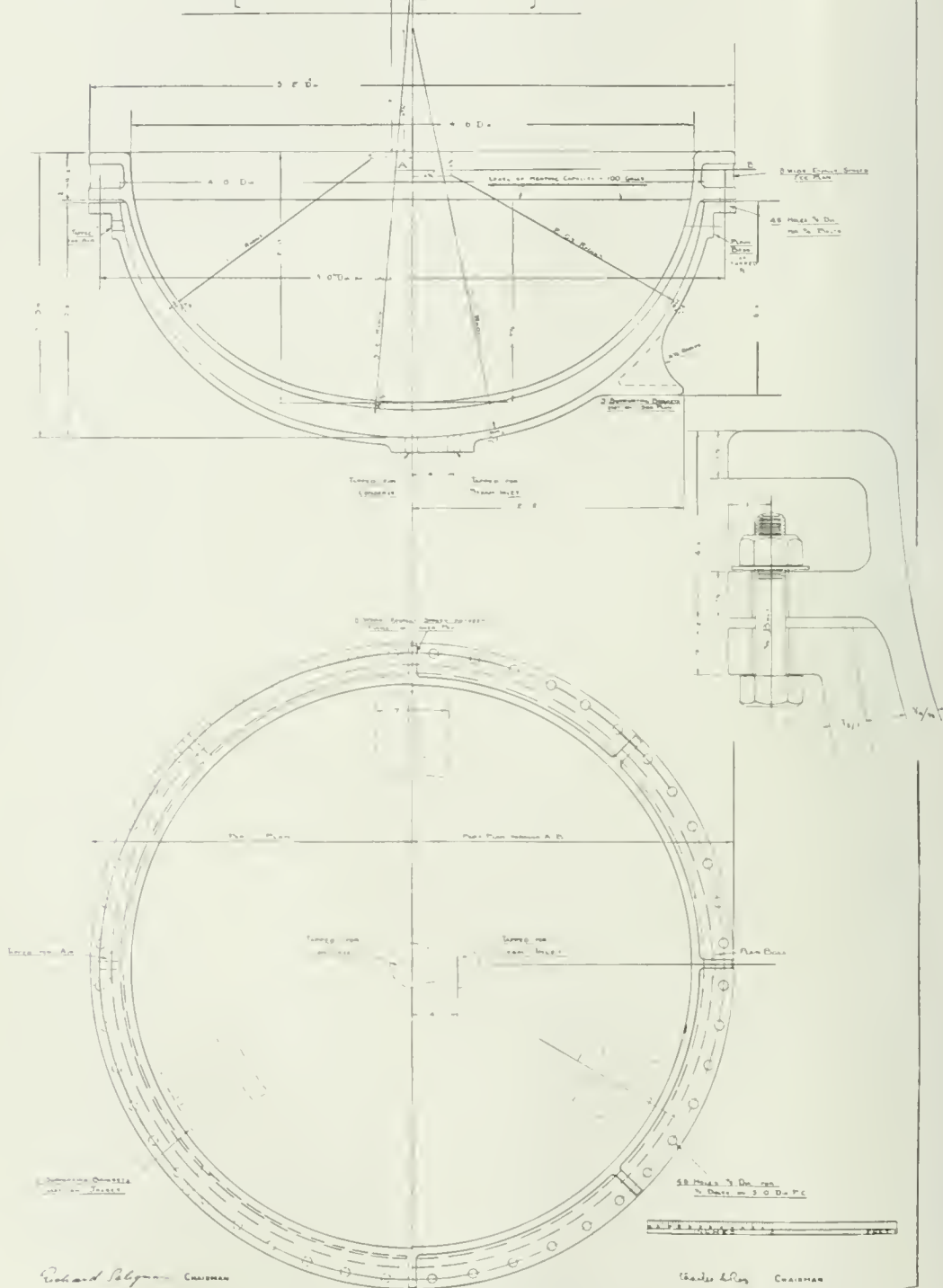
Tests as above, with the exception of the steam test, which is to be applied as follows:—The pan to be filled to limit capacity with cold water, steam to be applied to the jacket at the working pressure, and the contents boiled. After boiling from 5 to 10 minutes the water to be removed and the steam to be kept applied for at least 15 minutes to show up pinholes, flaking or crazing.

The above is the substance of the introduction to the report, which also contains a table of specified dimensions and nine drawings of the following sizes of enamelled, cast-iron, standard steam-jacketed pans:—

Working capacity. gallons.		Actual capacity. gallons.
10	.. .. .	15
25	.. .. .	34
50	.. .. .	63
100	.. .. .	128
150	.. .. .	180
200	.. .. .	233
SHALLOW TYPE.		
25	.. .. .	43
50	.. .. .	73
75	.. .. .	112
100	.. .. .	139

The table of dimensions and three drawings are reproduced on the following pages. The full report may be obtained from the British Chemical Plant Manufacturers' Association, at 166, Piccadilly, London, W. 1, price 2s. 6d.

ENAMELLED **100 GALLON** CAST IRON
STANDARD SHALLOW STEAM JACKETED PAN.
 100 GALL WORKING CAPACITY
 139 - ACTUAL



1974 London General Manager
 THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS,
 THE BRITISH CHEMICAL PLANT MANUFACTURERS ASSOCIATION.

ENAMELLED

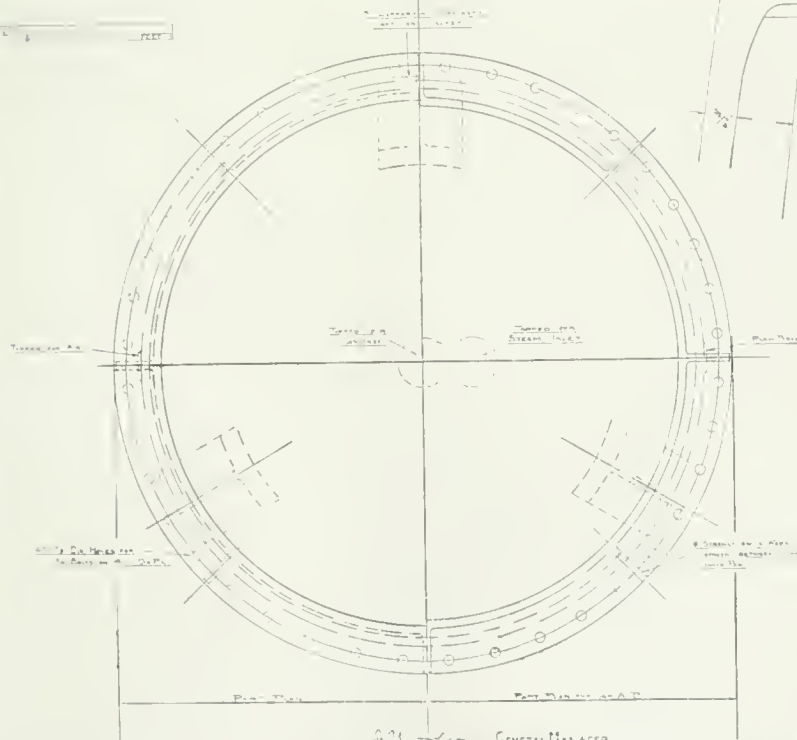
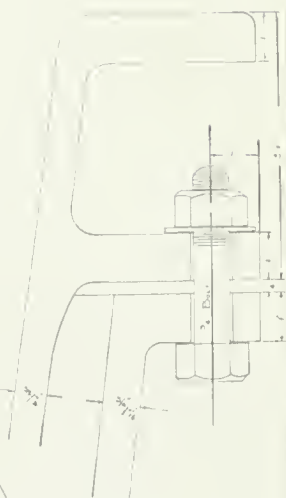
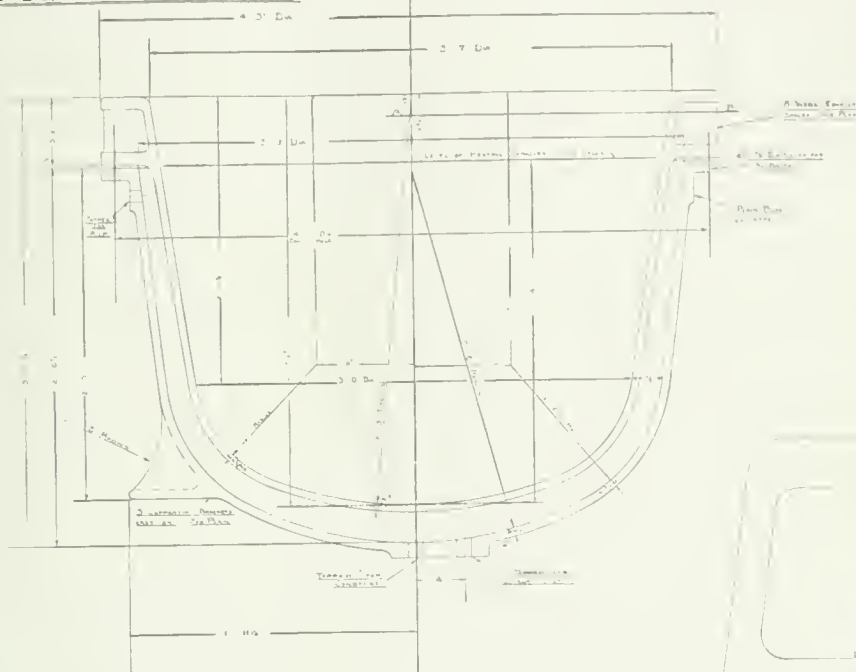
100 GALLON

CAST IRON

STANDARD STEAM JACKETED PAN.

100 GALL. WORKING CAPACITY.

128 GALL. ACTUAL CAPACITY.

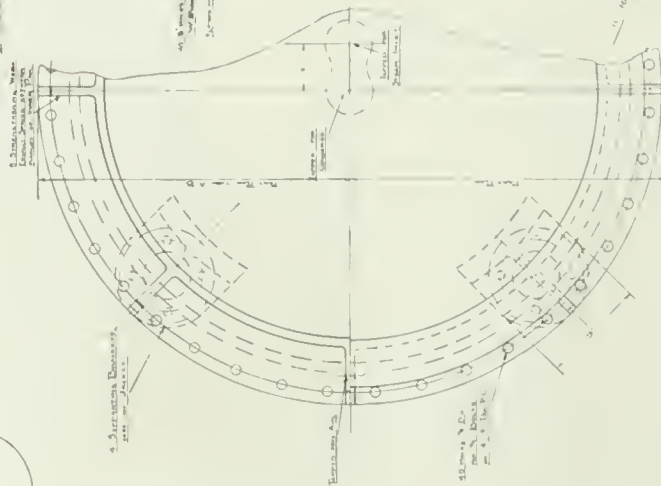


JOINT RESEARCH COMMITTEE

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS,
AND OF
THE BRITISH CHEMICAL PLANT MANUFACTURERS ASSOCIATION.

W. J. J. CHAIRMAN
JACKETED PANS STANDARDISATION
SUB-COMMITTEE.

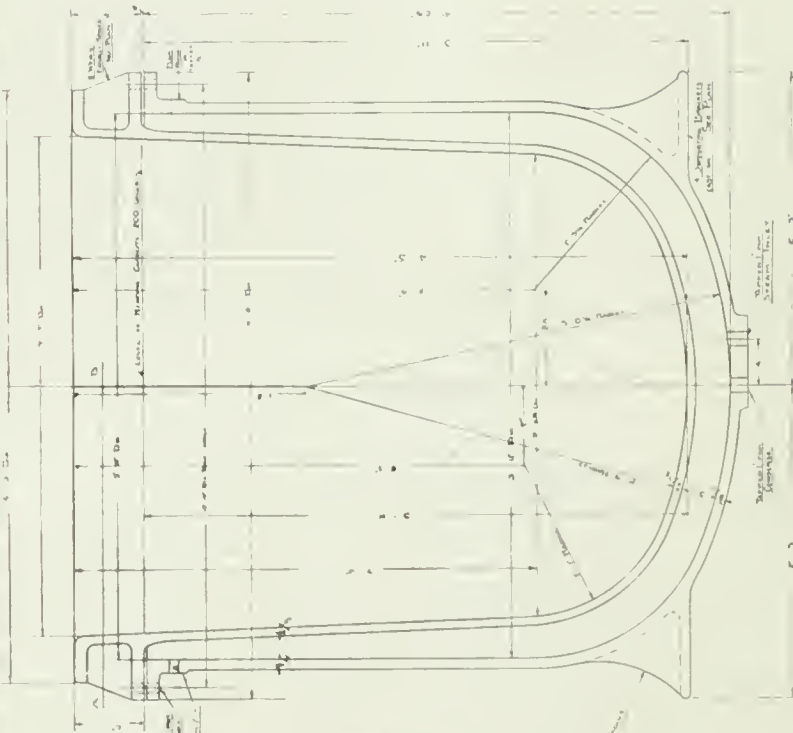
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13-20-21

JOINT RESEARCH COMMITTEE

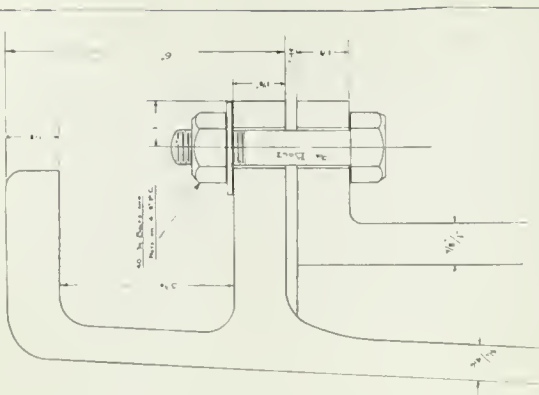
200 GALLON
STANDARD STEAM JACKETED PAN.
200 GALL. WORKING CAPACITY. 233 GALL. ACTUAL CAPACITY.



13-20-21

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS,
THE BRITISH CHEMICAL PLANT MANUFACTURERS ASSOCIATION

CAST IRON



JACKETED PANS STANDARDISATION
SUB-COMMITTEE.

London 21/1/21

MEETINGS OF OTHER SOCIETIES.

SOCIETY OF GLASS TECHNOLOGY.

A meeting was held in Sheffield on January 18, Dr. M. W. Travers presiding. The agenda included three papers and a general discussion on the durability of glassware. The first paper, by Mr. W. L. Baillie, on "An Examination and Extension of Zulkowski's Theory of the Relation between Composition and Durability of Glass," was presented in abstract by Prof. W. E. S. Turner.

Zulkowski's theory assumes that in the founding of glass simple silicates of the alkalis and alkaline earths are first formed and that these substances subsequently unite to produce double silicates, which he regarded as the essential constituents of all good glassware. The second reaction is the slower and is not complete unless the melt be kept at a sufficiently high temperature for an adequate time. Zulkowski assumed that all the bases compete equally for the acids and that all the ingredients in the batch enter completely into reaction, and he regarded the presence of simple silicates as the prime cause of instability in glasses. His method of calculating durability consisted in expressing the proportion of simple silicates formed either as a percentage by weight of the total or as the number of molecules of simple silicates per 100 molecules of double silicates; it gave a fairly accurate indication of the relative durability of glasses of the simple crown type but failed to explain the durability of glasses containing a relatively large proportion of alumina and boric oxide. The author has deduced a more complete mathematical expression, which he terms the "reactivity coefficient." For a glass having the molecular composition: —SiO_2 a%, R_2O_2 b%, RO c%, R_2O d%, he has deduced the expression

$$\left(\frac{c \pm d}{c + d} \right) (c + d - 3b)$$

and found that it is more widely applicable (*e.g.*, to glass high in boro- and aluminosilicates) than the simpler expression $(c \pm d)$ of Zulkowski.

In his paper entitled "A Critical Note on the Methods of Determining the Durability of Glass," Prof. Turner discussed one or two methods in fairly general use. Results, he said, should not be given in terms of loss in weight due to the attack of reagents, but as amount of alkali liberated. Results were affected by the form of the test-pieces; different results were given by flasks and beakers, and even by flasks of different shape; and immersed test-pieces gave different results from those obtained when only one surface was in contact with the reagent.

A third paper, "The Effect of Magnesia on the Durability of Glass," by Miss C. M. Muirhead and Prof. Turner, was read by the latter. Resistance of lime and soda glasses to attack by water was determined by tests made on the samples crushed to mesh 20–30, and boiled for 1 hour; more sodium oxide was liberated from the lime- than from the magnesia-glass. Boiling in hydrochloric acid for 6 hours showed that a glass containing small amounts of magnesia was much more resistant than the corresponding lime-glass, and the effect of increasing the magnesia content was less marked than the effect of increasing the lime. Magnesia-glasses were found to be less resistant than lime-glasses to both sodium carbonate and caustic soda, after boiling for three hours; and the loss in weight was greater with the carbonate than with the caustic alkali. Broadly speaking, there was not much difference in the durability of lime- and magnesia-glasses; one set was superior towards one particular reagent and the other set towards another reagent.

SOCIETY OF DYERS AND COLOURISTS.

A meeting of the Manchester Section was held on January 20, with Prof. E. Knecht in the chair. Papers were read by Mr. R. L. Taylor on "Some Notes on Hypochlorous Acid and Chlorine, with a Comparison of their Bleaching Action," and by Mr. E. J. Sidebotham on "Some Causes of the Staining of Printing Fabrics, with some General Remarks on Moulds."

Mr. R. L. Taylor compared the bleaching action of hypochlorous acid and chlorine in very dilute solution, and concluded that chlorine is more effective for certain colours. The view that chlorine is a feeble bleaching agent because it does not bleach linen is erroneous, for hypochlorous acid also fails to bleach it. The action of very dilute chlorine water on litmus infusion (the colour passes through bright red to purple and then disappears) suggests that chlorine acts directly on the colouring matter by chlorinating it, and not through nascent oxygen liberated from water. If this explanation be correct the theory of chlorine bleaching will need modification. In the discussion Mr. J. Huebner suggested that the bleaching action of chlorine could be better tested on paper pulp, and Dr. Coward suggested that the examination of solutions of weak bases, *e.g.*, alumina or ferric oxide, in hypochlorous acid might give useful results, as such solutions would contain very few hypochlorite ions.

Dr. J. E. Sidebotham ascribed the staining of two samples of printed fabrics to (1) a mould which had spread from the board on which the fabric was wrapped, and (2) to tar which had been dissolved by oil contained in the cloth (hessian). Several speakers contributed accounts of the attacks of moulds on cloths dyed with various colouring matters.

The meeting of the Nottingham Section, held on February 2, was devoted to a discussion on bleaching processes. The chairman, Mr. S. J. Pentecost, said that uneven dyeing could generally be traced to faults in bleaching and scouring; thus, uneven exposure to strong lye in the keir led to partial mercerisation and local shrinkage, and even lye of 1° Tw. affected the affinity for dye.

Mr. G. F. Hardeastle compared the bleaching effects of sulphur dioxide and hydrogen peroxide. He said that stoving with sulphur dioxide gave a good, but not a pure, white, and the colour was apt to return, especially after treatment with alkali; contrary to the usual opinion, sulphur dioxide persisted in wool and might destroy the colour of certain dyes either at once or subsequently. Hydrogen peroxide cost more but gave a purer white which was permanent. Mr. Edwards said that good elasticity could be obtained if hydrogen peroxide were used properly; on one occasion after a wool and cotton mixture had been stoved with sulphur and exposed to air the cotton rotted completely owing to the production of sulphuric acid. Regarding the effect of bleaching on dyes, Mr. Newsome called attention to the purpling of chrome brown and the greening of chromo yellow after stoving, and Mr. Hardeastle stated that colour changes also took place with direct cotton browns, as these were sensitive to acid and as much as 6 to 7 per cent. of sulphuric acid might be present in the fumes of burning sulphur. Mr. Pentecost said that silk dyed pink or sky had been bleached by sulphur dioxide present in gelatin.

The damage done to union goods by careless methods of stoving was discussed by Major Trotman, who said that the cotton was often entirely converted into hydrocellulose by the sulphuric acid, and he quoted experiments to show that permanganate was an excellent and cheap bleaching agent for such goods. Cotton bleached in this way contained less oxycellulose than that bleached by other methods. Mr. Wilkie suggested the use of

dilute aqueous glycerin for removing oxides of manganese and emphasised the importance of frequent analysis of hydrogen peroxide used for bleaching. Mr. Hardcastle confirmed the good effects of permanganate, if an excess were avoided; in neutral solution caustic potash was set free and injured the fabric.

SOCIETY OF PUBLIC ANALYSTS.

The annual general meeting was held on February 1, when the retiring president, Mr. A. Smetham, delivered the annual address, and the following new officers were elected:—President, Mr. P. A. Ellis Richards; vice-presidents, Drs. C. A. Keane and G. W. Monier-Williams; members of council, Messrs. S. F. Burford, B. S. Evans, H. Heap, A. More, and W. R. Schoeller. Mr. E. R. Bolton is now the sole hon. secretary and Mr. R. G. Pelly is assistant hon. secretary.

At the ordinary meeting which followed, Messrs. W. Dickson and W. C. Easterbrook read a paper on "The Quantitative Separation of Nitro-body Mixtures from Nitroglycerin," details of procedure being given. In analysing explosives it is often necessary to separate mixtures of nitro-bodies from nitroglycerin, as all these substances are removed in the ethereal extract. The method devised by the authors for determining nitro-body in presence of nitroglycerin consists in destroying the nitroglycerin with ferrous chloride or sulphate, methyl alcohol being added to inhibit further nitration of the nitro-body. The nitro-body is then extracted with ether and weighed. The reaction is conducted in the cold to prevent loss of nitro-body by volatilisation.

THE ROYAL SOCIETY.

A paper entitled "Researches on the Chemistry of Coal. Part II.—The Resinic Constituents and Coking Propensities of Coals," by Prof. W. A. Bone and Messrs. A. R. Pearson, E. Sinkinson, and W. E. Stockings, was presented to the meeting held on January 26.

In the experimental portion of the paper it is shown that prolonged extraction of eight selected coals by typical resin-solvents has no appreciable effect upon their coking propensities, which are therefore not due to the presence of free resins.

A new method is described for isolating and purifying the resins of coals, and one so isolated from two typical bituminous coals is shown to have a molecular weight of about 450, agreeing well with the empirical formula $C_{21}H_{32}O_2$, and properties corresponding with those of a resene in Tschirch's classification of resins. The usual pyridine-chloroform method of extracting coals yields an admixture of resins with a predominance of non-resinous substances, chiefly of cellulosic origin, which are provisionally termed "humic" bodies. Most of these bodies are insoluble in ethyl ether, though soluble in chloroform, and may constitute up to 4 per cent., or more, of the coal substance of strong coking coals. It is concluded that the coking propensities of such coals are principally due to the presence, or the formation in them by heat, of such non-resinous "humic" substances whose fusion temperatures are below those at which they undergo rapid decomposition, although the still more complex substances of cellulosic origin, which form the main portion of the coal substance and decompose without fusion, have little or no influence upon the coking properties.

Papers were also presented "On the Scattering of β -Rays" (J. A. Crowther and B. J. Schonland), and on "The Influence of Temperature on Two Alternative Modes of Decomposition of Formic Acid" (C. N. Hinshelwood, H. Hartley, and B. Topley).

ROYAL SOCIETY OF ARTS.

At a meeting held on February 8, Mr. E. V. Evans lectured upon "Some Solved and Unsolved Problems in Gas Works Chemistry." In considering the advisability of the complete extraction of naphthalene from coal gas reference was made to the vapour-pressure determinations made by J. S. G. Thomas (*cf.* J., 1916, 506) and to their importance in view of the incorrect data upon which the industry had previously relied. The extraction by means of carefully steam-distilled anthracene oil was described, and the effect of the process in reducing the number of naphthalene deposits found in gas-service pipes was illustrated. Improvements were foreshadowed in the process for removing carbon bisulphide from coal gas, and reference was made to the decomposition of carbon bisulphide with consequent deposition of carbon within the by-path-tubes of inverted incandescent burners. The defects of the iron-oxide process for removing hydrogen sulphide and the tendency within recent years to develop processes which would avoid the use of so large a mass of solid reagent were indicated. Unsuccessful attempts have been made to oxidise preferentially hydrogen sulphide in coal gas to sulphur and water vapour by means of oxidants or catalysts at slightly elevated temperatures. Difficulties arose out of the formation of carbon oxysulphide and the oxidation of hydrocarbons. It has been proposed to carry out a similar reaction by passing the gas mixed with air over charcoal, but this process also removes hydrocarbons. The reduction of dyestuffs by hydrogen sulphide with liberation of sulphur and the subsequent oxidation of the resulting leuco-compound by air was demonstrated experimentally. In order to secure rapid oxidation the dyestuff chosen must give a soluble leuco-compound, and in applying the reactions to coal-gas purification it has been found necessary to accelerate the absorption of hydrogen sulphide by means of an organic base such as pyridine or quinoline. Such refinements render uneconomical the technical application of the reactions as at present developed.

Reference was then made to the risks connected with the distribution of coal gas, and in order to show the need for a properly balanced evaluation of those risks the toxic nature of tobacco smoke was demonstrated. The products drawn into the mouth contain traces of hydrocyanic acid and hydrogen sulphide, the latter being in far greater concentration than in purified coal gas. In addition the smoke from a cigarette contains up to 1 per cent. carbon monoxide and that from an irregularly smoked cigar up to 7 per cent. With four people smoking cigars in one room the carbon monoxide content of the air might be equivalent to an appreciable escape of gas.

One important function of the gas-works' chemist is to watch over the consistency of the quality of coke, which is so dependent upon that of the coal from which it is derived. If the ash-constituents could be removed from coal prior to carbonisation there is no reason why coke should not entirely replace raw coal for industrial purposes. A brief description was given of the process worked out by E. R. Sutcliffe and E. C. Evans, by which coal is ground to a fine powder, washed by a flotation process, dried, mixed with a small quantity of breeze to prevent expansion during carbonisation, briquetted, and carbonised. On combustion of the coked residue the ash falls as a fine powder, free from combustible matter. The problem of coke as a domestic fuel was then considered from the standpoint that the financial soundness of high-temperature gas-production had been proved. The expediency of a separate domestic fuel-industry was questioned. Specimens were shown of a smokeless fuel which had been made by heating a mixture of

gas coke and coal, without briquetting or adding any other binding agent, to the temperature of the waste gases in the retort house. It was stated that the material ignited as readily as coal, but that, although the ash fell away as a powder, there was an objectionable quantity of it formed because of the absence of a coal-washing process. It was shown how gas undertakings would themselves derive benefit from the abatement of smoke, which is responsible for the blackening of ceilings, so often cited as an objection to the adoption of incandescent gas burners.

THE PROPOSED INSTITUTION OF CHEMICAL ENGINEERS.

The provisional committee has met on three occasions since January 1 and the constitution of the proposed Institution (*cf.* J., 1921, 428 R) has been thoroughly discussed with the aid of a legal advisor. It was decided to incorporate the Institution as a limited liability company, limited by guarantee, and, with the permission of the Board of Trade, to omit the word "limited"; also that there should be two classes of corporate members, viz., members and associate members, and the following three classes of non-corporate members: members, honorary members, graduates and students. A proposal was considered to express the terms of life-membership in the form of the equation,

$$y = (28 - \frac{2x}{5})z,$$

where x is the age of the applicant, z the annual subscription in force at the time of election, and y the sum payable on election, exclusive of entrance fee.

The amount received in subscriptions up to February 1 was £970, and it was decided to appeal to firms and individuals for help in founding the Institution. An advisory committee consisting of all those who have shown an active interest in the project is to be formed, and the draft memorandum and articles of association will be submitted to it before a meeting is convened to approve the work of the provisional committee.

CORRESPONDENCE.

THE SAFEGUARDING OF INDUSTRIES ACT.

SIR,—Among the cases which have so far come before the Learned Referee under the "Safeguarding of Industries Act," the "Santonin Case" has proved one of especial interest and importance to the chemist, particularly because of the decision which was given.

The case shows clearly the want of more accurate definitions of the terms involved; such should have been obtained before the Bill became an Act.

In the santonin case the first point to decide—"What is a chemical?"—came as a surprise to many who had never questioned whether santonin was a chemical. A definition of a chemical was demanded by the Referee, and the five witnesses concerned gave definitions which disclosed a great diversity of opinion on the subject. The case ultimately turned on whether a substance produced naturally is a chemical or whether it is not, i.e., is the term chemical restricted to substances brought into existence by an artificial process?

It was decided that a chemical essentially must be produced by an artificial process and hence santonin, being a natural product, is not a chemical. Fortunately, the corollary that the man who experi-

ments with such products is a naturalist was not decided.

The fundamental difference between the various definitions of the key-word "chemical" was that certain witnesses gave restricted definitions, and in only one case (Mr. F. H. Carr) was a really general definition given. It would appear that certain definitions were given to suit the case instead of testing the case by a definition. This was, of course, the result of not having the terms previously defined. In my opinion it is essential that a general definition of the term "chemical" should be arrived at first; then if such be too broad for any particular purpose, the limitations can be added; not to formulate a definition containing restrictions at the outset. Such a general definition should be as follows:—

If the substance in the *pure state* has a uniform and definite composition and cannot be resolved into two or more substances except by undergoing change of identity, then such a substance is a chemical.

According to this commonly accepted view it will be seen that there is no distinction between natural and artificial substances and that therefore santonin is a chemical. Of course, such a definition may be too general for the specific purposes of the Safeguarding of Industries Act, but it is not designed to meet the requirements of any Act, and any restrictions required must be applied by schedule or otherwise. From what has been said, it is clear that in the minds of chemists santonin is a chemical, and as such it comes within the Act unless excluded by the terms "fine," or "synthetic organic," or by schedule.

In conclusion, although the Referee decided that santonin is not a "chemical," such a decision is rather like that of a guilty man securing a decision of "not guilty" owing to the power of his defence or to the weakness of the case for the prosecution. Such a verdict does not make the man innocent.—I am, Sir, etc.,

Nottingham.

J. B. FIRTH.

Feb. 3, 1922.

THE PROPOSED INSTITUTION OF CHEMICAL ENGINEERS.

SIR,—I wish to inform you that the Memorandum and Articles of Association of the proposed Institution of Chemical Engineers have been drafted by the Provisional Committee appointed for the purpose at the preliminary meeting held in the Engineers' Club, 39, Coventry Street, London, W.C., on November 9, 1921.

I know there are a number of chemical engineers in many parts of the country who up to the present have not expressed their interest in the proposed institution. If any of these gentlemen will place themselves in communication with me, I shall be most pleased to furnish them with full particulars of the project.—Thanking you in anticipation, I am, Sir, etc.,

J. W. HINCHLEY, Hon. Sec.

Imperial College, S.W. 7.

February 1, 1922.

CORRIGENDA.—Issue for January 31. *The Safeguarding of Industries Act*, p. 25 R, col. i., l. 7—8, in Mr. H. D. Richmond's definition of "chemical," for "chemical process" read "processes as outlined above." *News and Notes*, p. 32 R, col. i., last line, for "to 5155 tons" read "by 5155 t. to 86,096 t." Under *Legal Intelligence*, p. 36 R, col. ii., l. 35—36, Mr. W. M. G. Young's evidence: in lieu of "would be very corrosive" insert "was not corrosive."

NEWS AND NOTES.

FRANCE.

Industrial Notes.—*The Chemical Industry.*—Fine chemicals are in poor demand, and many factories have had to restrict production, but the demand for heavy chemicals is still good, delivery being sometimes difficult. In the heavy chemical industry production of sulphuric acid is temporarily reduced owing to the shortage of pyrites, which are now obtained from Sweden instead of Spain, where prices have been forced up by heavy customs duties. It is difficult to find outlets for the large stocks of sodium sulphate, although there is a better demand from glassworks, which are gradually resuming operations. Prices of turpentine oil and resinous products have fallen, but probably only temporarily. The production of alcohol during the first three months of the distilling season was 16,524,310 gallons, as against 15,218,038 gallons in the same period of last year. Rubber manufactures are in better demand owing to the low price of the raw material.

Much interest is being shown in experiments made in Toulon to discover subterranean sources of water by means of electromagnetic apparatus which detects the radiations emitted by them.

Metallurgy.—Although reconstruction of works in the devastated areas has continued steadily during the past year, progress has been limited by the financial resources of individual firms. Several steel works are ready to begin work, and those at Midjeville and Ilomécourt, Nord-Est and Denain-Auzin will resume production during the year. Financially, the past year was very bad for the industry, and especially for works just restarted in the devastated areas. Progress in 1922 will probably be very slow until the political situation improves, but with adequate financial support all the devastated works should be reconstructed by 1925 or 1926. The production of pig iron and steel in 1921 is estimated at 3–3.5 million metric tons, and it is hoped to produce eventually 11 million t. annually, excluding Lorraine; the pre-war production was 5 million t.

Coal.—Before the war the consumption of coal in Franco and Alsace-Lorraine was 75 million t., but owing to the poor demand only 45 million t. was consumed in 1921. In the devastated areas production rose from 353,000 t. in January, 1921, to 541,000 t. in October. Steady progress is being made in the reorganisation of the industry on up-to-date lines; new quarters are being built for the workers, and skilled foreign labour is being introduced gradually.

UNITED STATES.

Carbon Black Produced from Natural Gas in 1920.—Carbon black as known to the American trade is a fluffy, velvety black pigment produced by incompletely burning natural gas against a metal surface. It is very finely-divided, free from grit, readily miscible with oil, has a unique brilliancy, intense colour, and remarkable covering power when mixed with other material. For most purposes, it is stated to be superior to lampblack. Production is now confined to six States, of which West Virginia and Louisiana account for nearly 90 per cent. The industry migrates to localities where supplies of natural gas are available; certain States have passed legislation to conserve natural gas for use as a domestic fuel. The following data are given of the production, etc. in 1919 and 1920:—

	1919.	1920.
Gas consumed (1000 cb. ft.) ..	49,896,235	40,598,978
Carbon black produced (lb.) ..	52,056,941	51,321,892
Average yield per 1000 cb. ft. (lb.) ..	1.04	1.26
Value (\$)	3,816,040	4,032,286
Average price per lb. (cents.) ..	7.3	7.9
Number of plants ..	30	39

The yield of carbon black from natural gases follows very closely their content of ethane, calorific value, and carbon content. About 40 per cent. of the output is used as a colouring material in the rubber industry, 35 per cent. in manufacturing printers' ink, and 10 per cent for miscellaneous uses, e.g., for making stove and boot polish, gramophone records, black leather, electric insulators, drawing and marking inks, celluloid, and carbon papers; about 15 per cent. is exported. Carbon black is now rapidly displacing zinc oxide as a filler for rubber tyres, as it increases their tensile strength and elasticity by 25 and 10 per cent., respectively.—(*U.S. Geol. Surv.*, Oct. 13, 1921.)

AUSTRALIA.

The Australian Chemical Institute.—According to the fourth annual report of the Australian Chemical Institute, which was founded in 1917, the membership at June 30, 1921, was 637, and was distributed as follows:—Victoria 237, New South Wales 225, Queensland 59, South Australia 67, and Western Australia 49. Twenty-six fellows were admitted during the past year, and there are now 13 student members. The report of the council refers to the loss of the services of Prof. H. G. Denham, on his appointment to the chair of inorganic chemistry in the University of Cape Town, and to the work of the Appointments Bureau. Consideration of the cost of training has led to the provisional conclusion that £300 should be adopted as the minimum salary of a qualified chemist. The constitution of the Institute is similar to that of the Institute of Chemistry of Great Britain and Ireland, and the standard of qualification required for admission to membership is to be raised by 1924 to enable a Royal Charter to be obtained; meanwhile the Institute is to be incorporated under the Companies' Act of New South Wales.

BRITISH INDIA.

Crop Forecasts.—*Indigo.*—In the final forecast for 1921–22 the area under this crop is estimated at 316,000 acres and the yield of dye at 3045 tons, representing increases of 32 and 48 per cent., respectively, over the final estimates of the past year. On the whole the season has been favourable and the crop is in good condition.

Oilseeds.—The following is the first forecast for 1921–22 of winter oilseeds in districts containing 98.6 per cent. of the total area under rape and mustard and 99.2 per cent. of the total area under linseed. The area under rape and mustard is estimated at 3,354,000 acres, which is 19 per cent. higher than the first estimate and 17 per cent. above the final estimate of last year, excluding the mixed crop of the United Provinces. For linseed the estimated area is 2,001,000 acres, an increase of 14 per cent. over the first and final estimates of the previous season. At sowing time the weather was favourable, and the present condition of the crop is good, but future prospects depend on winter rains.—(*Ind. Tr. J.*, Dec. 29, Jan. 5, 1922.)

Industrial Notes from the United Provinces.—*Bone Manure.*—It is proposed to erect a bone-crushing plant in connexion with a demonstration farm in the Meerut district, and a bone-meal factory in the neighbourhood of Cawnpore. Much of the product will probably have to be exported.

Glass.—Efforts are being made to establish up-to-date glass works in Bahjoi, and it is reported that over 60 per cent. of the required capital (Rs. 8,00,000) has been subscribed. In Shikohabad, the Western Indian Prospecting Syndicate has started its first up-to-date furnace, and it is intended to add four or five more when fireclay and silica bricks, which are on order, are available. In Firozabad the various manufacturers are turning out bangles of a more attractive kind, and Messrs. Framroz and

Co. have put down power-driven machinery for polishing and turning. Despite apprehensions that the Indian market would be inundated by cheap Austrian wares, Pirozabad has been able to hold its own.—(*J. Ind. Indust.*, Nov., 1921.)

Bismuth in Tenasserim.—According to the Geological Survey of India, small quantities of native bismuth have been found for some time past in the eluvial deposits of both the Tavoy and Mergui districts of Burma. In the former, the bismuth is always much oxidised, but on fracture the fragments are found to contain a kernel of unoxidised metal. A lode of native bismuth has been found in the Kanbauk mine associated with wolfram, cassiterite and sulphides.—(*J. Ind. Indust.*, Nov., 1921.)

Industrial Notes from the Bombay Presidency.—*Magnesium Chloride.*—Efforts to improve the colour of the magnesium chloride produced at Kharaghoda have so far been unsuccessful, and as the price of the German salt has been considerably reduced it is probable that the real fight of the local industry for a market is only just beginning (*cf. J.*, 1921, 368 n).

Casein.—The slump in casein prices has brought the Indian industry to a standstill, as it cannot work at a profit. Despite the unfavourable outlook, experimental and demonstration work are, however, being continued. Samples of casein glue tested at the Madras pencil factory were reported to dry too soon, but fresh samples prepared from a modified formula have been sent for further trial.

Vegetable Oil Industry.—A bulletin has recently been issued which contains valuable technical and commercial information. Methods of treating different kinds of seeds are fully described and the value of various types of oil-pressing machinery carefully estimated. The bulletin may be obtained from the Director of Industries, New Custom House, Bombay (price Rs. 1-13, postage 4 annas).

An investigation is proceeding on the reduction of the acidity of castor oil in view of its utilisation in aeroplane-engines in India.—(*J. Ind. Indust.*, Nov., 1921.)

CANADA.

Industrial Notes.—In 1921 Quebec produced 1,375,635 gallons of maple syrup, which is slightly less than the output of 1920 (1,449,649 gallons).

The production of honey in the province of Quebec has increased from 1,500,000 lb. in 1914 to 3,800,000 lb. in 1921. The farmers interested have increased from 3200 to 6300.

The provincial government of British Columbia has shipped to Darlington, England, 45,000 lb. of magnetite ore from the Lake mine, on the west side of Texada Island, for experimental purpose. The results of the tests have not yet been made public.

The plant of Scottish Fertilizers, Ltd., Welland, Ont. (Messrs. A. Cross and Co., Ltd., Glasgow), is nearing completion, and should be ready to commence operations early in the new year. British chemical engineers designed the plant, which embodies some of the best ideas of British and American practice.

The American Smelting and Refining Co., proprietor of the Premier Mine, British Columbia, has nearly completed its aerial tramway, about thirteen miles in length, connecting the mine with tidewater on Portland Canal. When equipped this mine is expected to produce \$1,000,000 of silver and \$500,000 of gold per annum.

Oil-Shale.—The oil-shale deposits of Indian Mountain, Westmoreland, New Brunswick, about 12 miles N.W. of Moncton, were investigated last summer. The results indicate that the exposed shale-beds contain 200 million tons with an average yield of 30 galls. per ton. The shale does not yield quite so much oil and ammonia as the Albert shales, but the deposits are situated within two miles of the Canadian National Railway.

The D'Arcy Exploration Co. (subsidiary of the Anglo-Persian Oil Co.) has had an experimental retort (Wallace patent), with a capacity of eight tons daily, operating at Rosevale, Albert County, New Brunswick, for four or five months, upon the oil shales of the district. The results obtained average 32.7 galls. of crude oil per ton of shale. It is reported that the Anglo-Persian Oil Co. is considering the erection of a plant with a throughput of 5000 tons per diem. The Exploration Co. has drilled a number of wells for gas and oil in Kent and Westmoreland counties without obtaining results.

A Canadian Press despatch from Halifax announces that British capital, to the extent of £5,000,000, has been pledged to finance the development of the oil-shale fields of Pictou, Nova Scotia. It is stated that this has been arranged with representatives of the oil organisations of Great Britain and of the Petroleum Executive of the British Government. The announcement is not taken seriously in Canada, as it is well known that the Nova Scotia Steel and Coal Co. has filed a protest with the Mines Department against granting leases on their coal areas for shale mining, as it would interfere with coal-mining operations. These shales were operated prior to the discovery of petroleum in the United States, and the shale was exported to the States for distillation. It is estimated that there are 500 million tons of shale in the district.

GENERAL.

Notes on the Furnishing and Equipment of Chemical Laboratories.—A pamphlet bearing this title has been issued by the Chemical Society describing the results of the work of a committee of three appointed in 1920 to consider the possibility of effecting economies in the equipment of laboratories. The experience of a large number of laboratories has been drawn upon for data concerning working benches, shelves for reagents, fume-cupboards, sinks and waste-water channels, ventilation, etc., and a short bibliography relating to English, German and American laboratories is appended.

Experiments carried out at Edinburgh University on the suitability of lime, ash, elm, beech, and sycamore woods for laboratory bench-tops showed that only beech withstands satisfactorily the action of water, acid and alkali; in October last its price was about one-fourth that of teak. Tiles and stones have been found more serviceable for fume-cupboards than slate, and asbestos-cement material has also proved satisfactory. Glazed earthenware is considered to be the best material for sinks and waste-water channels, and the view is expressed that in general the provision of sinks is overdone. The use of stainless (unstainable) steel for water-taps is regarded as hopeful. In the new laboratories at Oxford and Cambridge it has been found that the disadvantages of using steam for heating, evaporating, etc. outweigh the advantages. Glazed bricks are considered the ideal material for the walls of a chemical laboratory, although ordinary brick has been found to be very resistant, and sand-lime bricks are used extensively in several countries. The use of magnesium-oxychloride cement for flooring is attended by the disadvantage that it is very corrosive to iron-work when in contact with it.

"Talc (1913-1919)."—This publication of the Imperial Mineral Resources Bureau (pp. 23, price 9d.) contains a digest of statistical and technical information relating to the occurrence, production, and values of talc. The properties and uses of the mineral are first described, a summary of the world's production is then given, followed by notes and tables concerning sources, outputs, etc. in the chief producing countries. In most cases details of imports and exports of talc are also given. The United States is the greatest producer and con-

summer of talc and soapstone (*cf.* J., 1921, 255 R). Before the war France stood second in the list of producing countries and Italy third, the larger portion of the output from these countries being of a high grade, suitable for toilet preparations, etc. In Germany, Austria and the United States medium-grade talc is extensively used; but in nearly all other producing countries only the highest grades are mined, because the lower-grade materials will not stand transportation charges. Spain, Brazil, Uruguay, India, Japan, and China all contain large deposits, but these are little worked.

The United Kingdom.

Production and Imports of Talc, 1913—1919.

Year.	Production. Long tons.	Imports.		Chief Sources.			
		Long tons.	Brit. %	Fr. %	Italy. %	U.S.A. %	
1913 ..	40	11,214	9.5	44.4	22.1	2.3	
1914 ..	180	11,975	5.8	55.4	22.1	1.9	
1915 ..	850	14,101	4.0	46.2	25.7	15.1	
1916 ..	301	15,170	0.5	48.3	24.2	22.1	
1917 ..	1233	12,785	—	73.6	15.9	9.7	
1918 ..	936	15,183	—	88.5	9.4	1.1	
1919 ..	686	11,843	0.9	59.1	15.3	8.7	

Storage of Ammonium Nitrate.—The following is a summary of a notice issued by the Prussian Minister of Trade and Industry:—

Although the cause of the Oppan explosion is not fully understood, the conclusion has been reached that a mixture of, roughly, equal parts of ammonium nitrate and ammonium sulphate can be made to explode by a very strong initial detonation, for recent experiments have shown that such a mixture can be exploded in a steel cylinder with a picric-acid primer. Therefore mixtures of ammonium nitrate and sulphate or of the nitrate and potassium chloride, whether they be regarded as consisting entirely or partly of double salts, must not be broken up by blasting after they have set hard; and this applies equally to ammonium nitrate, which under certain conditions is also explosive.

To prevent ammonium nitrate and its mixtures from hardening, dumps should be kept as shallow as possible. Wood should be kept away from nitrate stored in a loose state; flooring and walls of stores should consist of incombustible or unoxidisable material such as clinker, flagstone, or asphalt; and empty cases, casks, sacks, etc. should not be left about. Smoking and the use of naked lights should be prohibited. These precautions also apply to buildings in which other substances besides ammonium nitrate are stored. The nitrate must not be stored with materials that oxidise easily or contain free acid (*e.g.*, superphosphate).

Compound fertilisers containing relatively little ammonium nitrate which cake on storage should not be blasted, because their intimate admixture cannot be regarded as certain. If, however, insuperable difficulties arise from the prohibition of blasting, information is to be given to the Minister. The Chemisch-Technische Reichsanstalt in Berlin is endeavouring to ascertain what fertiliser mixtures containing ammonium nitrate are not explosive, and what can be added to such mixtures to prevent setting on storage.—(*Chem. Ind.*, Jan. 16, 1922.)

The Dutch Margarine Industry.—The manufacture of margarine in Holland was initiated between 1871 and 1873 by Messrs. Van den Berghs and Jurgens who established factories in the village of Oss and used the process discovered in 1869—70 by the French chemist Mège-Mouries. The industry grew rapidly and in 1884 there were between 60 and 70 factories, but since then many of the smaller establishments have closed down. At first the animal oils were obtained mainly from France and Austria, but later large supplies of oleo were imported from the United States, where the meat-packing industry was developing rapidly. Rotterdam soon became the centre of the oleo trade and consequently in

1890 the Van den Berghs Co. moved its factory to that city. The discovery, patented in 1883, that vegetable oils could be used instead of, or with, animal fats was very important to Holland as, apart from the difficulty in obtaining sufficient supplies of animal fats, the Dutch colonies were beginning to produce quantities of vegetable oils; and a further radical change in the Dutch industry followed the adoption of Sabatier's process for "hardening" fats. Since then production and exportation have steadily increased. The following are the export figures of the Dutch Export Bureau:—

					Total Exports.	Exports to Great Britain.
1910 ..	..	..	..	..	56,400	53,170
1911 ..	..	..	..	..	46,000	42,800
1912 ..	..	..	..	..	59,800	55,600
1913 ..	..	..	..	..	71,000	65,000
1914 ..	..	..	..	..	80,000	72,000
1915 ..	..	..	..	..	156,000	104,000
1916 ..	..	..	..	..	166,000	158,000
1917 ..	..	..	..	..	106,000	104,000
1918 ..	..	..	..	..	17,500	17,400
1919 ..	..	..	..	..	54,000	26,000
1920 ..	..	..	..	..	93,000	51,000

The economic position of the industry is sound and prospects appear hopeful.—(*Times Tr. Suppl.*, Dec. 6, 1921.)

Honour to Prof. Moureu.—H.M. the King has been pleased to appoint Prof. Charles Moureu, professor at the Collège de France, Commander of the Order of the British Empire (C.B.E.).

LEGAL INTELLIGENCE.

FRENCH SYNDICAL TRADE MARKS. *In re Application of Union Nationale Intersyndicale des Marques Collectives, and in re Trade Marks Act.*

In the Chancery Division on January 25, Mr. Justice Peterson delivered judgment in an appeal by Messrs. Bass, Ratcliff, and Gretton, Ltd., Brunner, Mond and Co., Ltd., J. Crosfield and Sons, Ltd., Lever Brothers, Ltd., the United Alkali Co., Ltd., and fifteen other firms, from a decision of the Registrar of Trade Marks allowing the application of the Union Nationale Intersyndicale des Marques Collectives to register the words "Unis, France," as a trade mark for French goods.

In giving judgment, his Lordship said that according to section 62 of the Trade Marks Act, 1905, as amended by the Act of 1919, the Board of Trade was bound to determine whether the Union Nationale was competent to certify the origin of the goods to which the mark was applied, and whether the registration of the mark was to the public advantage. He thought that the Board had power to cancel a permission already given if it were no longer satisfied that the Union was competent to certify, and provided the mark had not actually been registered. He could not admit the complaint that the Board of Trade had acted *ex parte* without hearing opponents, for it was open to the latter at any time to lay before the Board their objections to the exercise of its powers under section 62. As to the objection that the Union did not undertake to certify the origin of the goods by mark, the Board had considered the question in relation to the requirements of the Act of 1905, but not from the standpoint of the Act of 1919; it had not come to the conclusion that the Union was competent to certify, and until it came to a conclusion it was impossible to say that it had taken a wrong view of section 62. The Board must consider this matter before the mark was registered, and if the opponents applied for an opportunity to state their case before the Board no doubt it would be considered.

Concerning the points proper for the consideration of the Registrar, his Lordship had no grounds for believing that French firms would be so dishonest as to insist that goods not bearing the mark were not French, or that the public would be deceived if they were. British manufacturers with branches in France could register a mark of their own if they chose. They had no grounds for complaint, because they could not use the mark appropriated to the use of an association of which they were not qualified to be members. The objections would be disallowed, and the appeal dismissed with costs.

REPORTS.

SALE OF FOOD AND DRUGS ACTS. EXTRACTS FROM THE ANNUAL REPORT OF THE MINISTRY OF HEALTH FOR 1920-1921, AND ABSTRACT OF REPORTS OF PUBLIC ANALYSTS FOR THE YEAR 1920. Pp. 16. London: H.M. Stationery Office. 1921. Price 1s. 6d.

The total number of samples purchased for analysis under the Acts during 1920 was 111,797, of which 7903 were reported as not being genuine. Of the 62,463 samples of milk examined, 9.3 per cent. was adulterated or not up to standard; in several cases substantial fines (£20-£45) were imposed, and a Camberwell vendor of milk was sentenced to five weeks' imprisonment. Many milk samples were artificially coloured, in most cases with annatto; the addition of colouring matter to milk is forbidden by the Milk Order, 1920.

The adulteration of butter took the form of entire or partial substitution of margarine, or the presence of water in excess of the legal 16 per cent.; 3.62 per cent. of the samples examined was reported as not being genuine; one sample from Anglesey was rancid and contained 11.7 per cent. of salt, and a sample submitted to the Public Analyst for Essex contained 25 per cent. of margarine. In the Tonbridge Wells district an itinerant vendor was sentenced to six months' hard labour for the sale of margarine as butter.

Opinions have been expressed in favour of a standard for cheese, as skimmed-milk cheese is sometimes sold as "cheese," implying thereby that it contains the full proportion of milk-fat. A sample examined by the analyst for West Hartlepool had been made from skimmed milk but was sold at the same price as high-quality whole-milk cheese; it contained 52 per cent. of water and only 7.27 per cent. of fat, and consequently had a food value about one-third less than that of ordinary cheese.

All the samples of coffee (1.5 per cent. of the whole) reported as adulterated contained chicory, one as much as 70 per cent. Adulteration of vinegar (1.5 per cent. of the samples examined) took the form of the use of artificial vinegar (coloured and diluted acetic acid), the addition of water, and substitution of non-malt for malt vinegar. Of the samples of self-raising flour and baking powder, a few contained a slight excess of calcium sulphate or insignificant traces of arsenic. The usual fault was a deficiency in available carbon dioxide, but there is no legal standard, and there is always the possibility of spontaneous liberation of gas. Eight out of 551 samples of egg preparations were reported as not genuine. Attention is called to the misleading descriptions given on the labels of many of the "egg-powders," which are merely coloured baking powders and contain only 0.3-0.8 per cent. of fat and about 5 per cent. of protein, whereas eggs would contain 10 and 14 per cent., respectively. In a few cases, solutions of phosphoric acid (with sugar, colouring and flavouring agents) have been sold as fruit cordials, such as lime-juice; one sample

examined contained 13.1 grains per pint of salicylic acid and 1.2 per cent. of phosphoric acid. Of drugs, 8.5 per cent. was reported as not being genuine, and of borax, 56 out of 182 samples, most of these containing small quantities of arsenic.

Substitutes, consisting of an acid phosphate with a diluent such as maize starch, are frequently offered for cream of tartar; in one case, a fine of £5 and £4 4s. costs was imposed for the sale of acid sodium phosphate with 12 per cent. of maize starch.

FINAL REPORT OF THE WATER-POWER RESOURCES COMMITTEE. *Board of Trade.* Pp. 178. London: H.M. Stationery Office. 1921. Price 8s. net.

The Water-Power Resources Committee was appointed in 1918 to investigate the water-power resources of the United Kingdom, but in 1919 the terms of reference were extended to include the conservation and utilisation of water for all purposes. Four interim reports have already been issued (*cf.* J., 1919, 151 r, 1920, 260 r), and the final report summarises practically the whole of the committee's work, exclusive of that on Ireland, which formed the subject of an interim report in 1921.

From the reports and evidence obtained the committee concludes that under the schemes considered a continuous output of 210,000 kw. (or 233,000 kw. including the Lochaber scheme) could probably be obtained at an economic rate from certain undeveloped water resources in Great Britain. This figure represents an annual output of 1840 million Board of Trade units, or about 40 per cent. of the total units generated during 1917-18 in the 410 public steam-power stations for electricity supply in Great Britain, and is equivalent to an annual consumption of nearly three million tons of coal burnt in steam plants. The bulk of the larger water-powers is situated in the Scottish Highlands, where 194,965 continuous kw. could be obtained, and although remote from industrial centres, no part of it is far from the sea or the Caledonian Canal. In Wales, where 35,900 kw. is potentially available, the cost of development would be considerably higher than in Scotland. The main sources of water-power in England are the low falls on the rivers, and it is suggested that the estimated total of 20,440 kw. could be greatly increased by installing modern plant, replanning existing sites, and improving the watercourses; thus on the Western Avon the plant to generate 650 kw. could be increased to provide a further 2300 kw. The most hopeful sources appear to be Devon, Cornwall, and the Lake District.

To ensure economical development the committee recommends the appointment of a Water Commission for England and Wales, whose principal work would be, *inter alia*, to compile records of water resources and requirements; to allocate water resources with regard to the public interest, and to readjust existing allocations where necessary; to adjust conflicting interests; to assist Parliamentary committees, Governmental and local authorities, and water-supply undertakings in the use and control of water for specific purposes; and to consider the development of rivers as a whole from source to mouth. Two members of the committee object to this proposal on the grounds of unjustifiable expense and inevitable duplication of work. It is also proposed that existing local water boards and allied bodies should be replaced by boards set up by the Water Commission, with power to supervise a particular river basin or groups of river basins.

The committee recommends that the utilisation of tidal power (treated in the 3rd interim report) be studied by a technical commission, with particular reference to the Severn Estuary, and that every inducement, including State aid during construction, should be given to power consumers to use water rather than a wasting asset like coal.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for January 26 and February 2.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Canada ..	Celluloid, leather	87
" ..	Medicines	89
" ..	Iron sheets	91
" ..	Electric incandescent lamps ..	127
South Africa ..	Water bottles, crown corks ..	131
" ..	China, earthenware	132
Denmark ..	Chemicals, pig iron, edible oils ..	96
" ..	Iron and steel plates and sheets, tinplate, galvanised, plain and corrugated sheets ..	137
Italy ..	Wood pulp, oils, greases, chemical products	140
Spain ..	Tinplate	102
" ..	Vegetable fibres	148
Switzerland ..	Medicines	104
Egypt ..	Photographic chemicals, plates and papers	7181/F.E./P.N.
" ..	Tin, tinplate, copper, chemicals (sul ammoniac, bichromate, potash, shellac, etc.) ..	120
Hijaz Klugdon ..	Aluminium, solder, tinplate ..	107
Dutch East Indies ..	Soap	106
Japan ..	Steel sheets and wire	108
United States ..	Casein	111
" ..	Oil colours, paint, glass	112
" ..	Iron and steel	114, 117
" ..	Caustic soda, soda ash, sodium bicarbonate, paint, pigments, ammonium sulphate, chalk, whitening, talc	115
" ..	Leather	116
" ..	Aluminium and nickel sheet ..	13753/F.W./S.C. 1
" ..	Vegetable oils	152
Brazil ..	Heavy and industrial chemicals ..	153
Panama ..	Soap	121

CUSTOMS. TARIFF. EXCISE.

Australia.—Importation of goods produced in Germany, Austria, Hungary, Turkey, or Bulgaria is to be permitted from August 1 next.

Austria.—The consumption and licence tax on artificial sweetening materials is fixed at 50 kronen per kg. and per saccharometric degree.

Denmark.—The tariff classification of various goods, including certain articles of moulded rubber and mica rings is given in the issue for February 2.

Fiji.—In the revised customs tariff preferential treatment is given to goods produced or made within the British Empire. Where specific duties are leviable the British preferential rates are usually one-half of the corresponding rates under the general tariff. Most of the general *ad valorem* rates are fixed at 27½ per cent. or 12½ per cent., and the British rates at 15 per cent. or "free."

Finland.—Particulars of rates of duty leviable under the new customs tariff may be obtained from the Department. Increased duties are payable on all imported goods.

France.—The import duties on beet seed have been modified.

Italy.—Export licences are no longer required for antimony ores, beet saline, linseed and maize cakes, cod-liver and linseed oils, residues of platinised asbestos.

Latvia.—Regulations governing the transit of merchandise through Latvia are given in the issue for February 2. Detailed information can be obtained from the Department.

Mexico.—Crude mineral oil may be imported free of duty as from January 1.

Paraguay.—The text of regulations controlling the importation and sale of pharmaceutical products or specialities may be consulted at the Department. An application for permission to sell pharmaceutical specialities must be made by a qualified pharmacist resident in the country and be accompanied by a complete formula, description of the manufacture and of the properties of the product, samples for analysis, etc.

Poland.—Amended customs regulations have been issued.

St. Christopher and Nevis.—A preferential tariff has been applied to goods produced or made within the British Empire. The customs duties on butter substitutes and whisky have been modified.

St. Vincent.—It is proposed to apply duties on articles such as coal, scientific instruments, copra, vinegar, lubricating oils, etc., which are now free of duty.

South Africa.—Export prohibitions affect scrap metals, sugar, and all goods of which the prices are or may be regulated by law.

Switzerland.—The control of stocks of paraffin oil and benzine has been abolished.

Tunis.—The import duty on "mazout" has been fixed at 0.40 francs per 100 kg. net weight and on lubricating oils, heavy oils and petroleum residues at 5 fr. per 100 kg.

Yugoslavia.—A copy of the regulations controlling the importation of pharmaceutical specialities into Yugoslavia may be consulted at the Department.

TRADE NOTES.

BRITISH.

Chemical Trade in the United Kingdom.—In a brief survey of the general industrial position the *Board of Trade Journal* (February 2) states that few chemical works are producing to capacity, and foreign competition is still keen. Export trade, which showed a steady improvement from July to October, ceased to expand during the remainder of the year, but there was a marked increase in the exports of copper sulphate and sodium compounds. Prices of chemicals and tar products show a consistent downward tendency, although higher prices for ammonium sulphate have now been fixed. During the past year the price of copper sulphate fell about 30 per cent., acetates of lime over 50 per cent., caustic potash about 65 per cent., and tartaric acid about 40 per cent. These reductions are typical.

Brazilian Centenary Exhibition.—The Brazilian Government is organising an international exhibition to be held in Rio de Janeiro from September 7 to December 31, 1922, to celebrate the centenary of Brazilian independence. Invitations to participate have been accepted by most of the leading nations, and our chief competitors in the Brazilian market are preparing to take full advantage of the opportunities offered. The British exhibits will be housed in a pavilion occupying the best site in the grounds, and, in view of the importance of the market and the strong local predisposition in favour of British goods, it is hoped that this country will be well represented. Full particulars of rates for space, etc., can be obtained from the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1.

British Industries Fair, 1922.—A special feature of the British Industries Fair, to be held at the White City from February 27 to March 10, will be the Chemical Hall, situated at the Shepherd's Bush entrance to the Fair. This Hall will be occupied entirely by 50 or 60 *bona fide* chemical manufacturers, who, together, will be more representative of British chemical industry than at any previous exhibition held in this country.

In addition to tar-products and heavy chemicals, in which this country has always been pre-eminent, the exhibits of fine chemicals and dyes promise to be particularly good, and an attempt will be made to demonstrate to overseas buyers the great strides which have been made in recent years in these particular branches of the industry. The firms exhibiting in the Chemical Hall are, with one or two exceptions, all members of the Association of British Chemical Manufacturers, under whose auspices the section has been organised. It is believed that such an exhibition arranged by a Trade Association is unique in the history of the British Industries Fair. With the exception of two or three privately-owned, all the stands will be of uniform design and colour, and on each will be exhibited an enlarged replica of the Association's official seal. A feature of the section, unusual in the great majority of such cases, will be the more or less systematic arrangement of the exhibits, which will consist of three main groups ranging from raw materials to finished fine chemicals:—

(1) Heavy Chemicals and Tar Products; (2) Dyes and Intermediates; (3) Fine Chemicals. In the first group will be found such well-known names as Albright and Wilson, Ltd., A. Boake Roberts and Co., Ltd., Burt, Boulton and Haywood, Ltd., South Metropolitan Gas Co., The United Alkali Co., Ltd.

The Dye Manufacturers will include: The British Alizarine Co., Ltd., The British Dyestuffs Corporation, Ltd., L. B. Holliday and Co., Ltd., and Scottish Dyes, Ltd., and among the Fine Chemical manufacturers will be found: Boot's Pure Drug Co., Ltd., British Drug Houses, Ltd., Burroughs Wellcome and Co., Howards and Sons, Ltd., May and Baker, Ltd., Thomas Morson and Son, Ltd. For the convenience of both visitors and exhibitors the Association will also provide an Information Bureau in the Section.

The Exhibition will, therefore, illustrate the diversity of interest, not only of members of the Association of British Chemical Manufacturers but of chemical industry generally, and there is no doubt that if British chemical industry is to maintain its place in the world, co-ordination by a central body is imperative in an age when international rivalry and competition are so keen. Great Britain has long been recognised as the cradle of the heavy chemical industry. It will be of interest, however, particularly to foreign buyers, to know that many fine chemicals, including pharmaceutical and photographic chemicals hitherto available only from Germany, are now being made in this country. Unless defeated by the present anomalous condition of international commerce, the British fine-chemical industry will become second to none in the world. It is to be hoped that the appeal to chemical buyers both from Home and Overseas will be effective, and that the Fair will give a much-needed stimulus to British chemical industry, and particularly to its export trade.

Gilbert and Ellice Islands in 1919-20.—The chief products of these islands, which include Ocean and Christmas Islands, are phosphate and copra. There has been a marked increase in the output of phosphate since the close of the war, the quantity exported having risen from 78,653 tons, valued at £78,683, in 1918-19 to 105,838, worth £153,757, in 1919-20. The production of copra was approximately 5000 t. in the former year and 3131 t. in the latter.—(*Col. Rep.-Ann.*, No. 1088, 1921.)

REVIEWS.

PRÉPARATION DES MÉDICAMENTS ORGANIQUES. By ERNEST FOURNEAU. Pp. viii.+350. (Paris: J. B. Baillière et Fils. 1921.) Price 25 francs.

This work consists of a series of lectures and directions for practical laboratory work, based on an actual short course given by the author in Madrid in 1917 and which continued for three months. Certain selected classes of synthetic organic medicaments are dealt with, as for example guaiacol and phenacetin, antipyretics, hypnotics, local anaesthetics, synthetic organic compounds of arsenic, mercury and phosphorus, and some alkaloids. M. Fournau's position as an organic chemist and his great ability as a manipulator are not unknown in Britain, and British chemists are not unmindful of the delicate and witty compliment paid by him to our language when he gave the name of *stovaine* to his new local anæsthetic—the hydrochloride of dimethylaminodiethylbenzoylcarbinol. His book may be regarded as representing the best French practice of teaching advanced organic chemistry, and as such it compares most favourably with anything we have in this country.

Chemistry was in the past an international science and many of its leaders to-day have had the advantage of coming under Continental as well as British influences during their training. It is all to the good that this should continue, and particularly that British students should be encouraged to visit France, where above all the quality of imagination is to be found. From this point of view it is especially desirable that M. Fournau's book should be put into the hands of our honour students. The literary style is most admirable and the exposition strikingly clear.

E. F. ARMSTRONG.

AUSKUNFTSBUCH FÜR DIE CHEMISCHE INDUSTRIE. Edited by H. BLÜCHER. Eleventh edition. Two volumes. Pp. xiv.+1590, and appendices. (Berlin and Leipzig: Vereinigung Wissenschaftlicher Verleger, W. de Gruyter and Co., 1921.) Price, bound, 35s. per volume.

Certain German chemists and chemical manufacturers have frequently been heard of late declaring their intention to refrain in future from publishing or patenting improvements or discoveries, alleging as justification for this regrettable attitude what they describe as the unfair action of Allied countries during the war towards the patent rights of Germans. This point of view is reflected in the preface to the eleventh edition of this useful work of reference; the editor groups the German fears of further action by the Allies with dread of internal revolution or socialist confiscation as causes explaining the reluctance of the larger chemical firms to communicate matter suitable for his publication as freely and fully as they have done in the past. On the other hand, the long interval which has elapsed since the appearance of the previous edition and the exceptional demands on the resources of chemical industry during the war have rendered necessary very extensive revisions and additions.

The work is a dictionary or condensed encyclopedia of chemical manufacture with a definite and useful, though limited scope. It is not intended in any sense as a handbook or treatise, and the specialist will probably find little to help him in his own special branch; it has, however, considerable value for a chemist who from time to time may have use for the facts concerning some branch of chemical technology or industry with which he is less familiar. In alphabetical order are described all substances of any importance which play a part in

chemical industry, with a brief outline of the process of manufacture, and the chemical and physical data of possible service in technical (including analytical) operations. Products which appear in commerce under trade or fancy names are, whenever possible, identified and their properties and uses described.

Within the limits imposed by the size of the volumes the matter is well chosen and exhibits painstaking search and condensation, but the advertisements which appear in the midst of the reading matter, although they refer to the supply and production of the substances described, are a great disfigurement to the text, and should be relegated to a separate section.

Former editions have included information regarding the current prices of chemicals, but the post-war conditions of uncertain exchange and extreme fluctuations in cost of labour and raw materials have necessitated the omission of this feature from the present volumes.

REGINALD BROWN.

CHEMICAL DISINFECTION AND STERILISATION. By S. RIDEAL and E. K. RIDEAL. Pp. vii.+313. (London: Edward Arnold and Co. 1921.) Price 21s. net.

This book deals broadly with methods for controlling the growth of undesirable micro-organisms in order to prevent, inhibit, or destroy them (by the introduction of special agents), wherever they manifest themselves in a manner detrimental to human beings, animals and plants. The authors, in their modesty, do not claim that the book deals exhaustively with this subject, and indeed an exhaustive treatise would of necessity include descriptions of the numerous industries which depend on biological agents; nevertheless the ground covered is very wide. The outstanding merit of the book lies in the fact that therein is marshalled and reviewed in one handy volume of 300 pages, an immense mass of varied and scattered literature covering an extraordinary variety of interests. Not merely is it a review, but rather a series of reviews, for each chapter is in itself a review dealing with some special branch of the subject, and its value is enhanced very greatly by the copious references given to the writings of other workers and authorities on whom the authors have drawn in constructing the volume.

Another good feature is the unusually full bibliography, given at the end of each chapter, of the literature dealing with the special branch of the subject elaborated in that chapter. Selection has evidently been done with considerable care, and the labour involved has been correspondingly great; but in doing this the authors have produced a book which in itself is a most useful work of reference. Quite an achievement, too, in view of the nature of the subject, is the readable style in which the book is written, and many of the matters dealt with, not lacking fascination because of their intimate concern with human welfare, may prove attractive even to the lay reader.

Of especial scientific interest is the subject matter of the chapter on Chemical Constitution and Germicidal Activity, in which are discussed the baffling and difficult problems of how the germicidal agent interferes with the normal life of the organism. Very fascinating are the questions raised by the incidence of the laws of physical chemistry on living matter; the germicide may stimulate, arrest, or completely destroy growth according to its amount and strength. Theories relating to coagulation of the cell contents, disruption or modification of the cell wall, interference with the free movement of the organisms, etc., are critically examined. There seems no doubt that the action of each germicidal agent is specific for each

type of organism. The "partition coefficient," i.e., the relation between the penetrability of the cell wall by an effective agent and its solubility in the cell contents as determining germicidal power, ionic and colloid disinfectants, etc., are dealt with, and some general conclusions based on the detailed actions under different specified conditions are given. Some definitions are given in the book that might very well be amplified. For instance, even the common terms antiseptic, germicide, disinfectant, are not specifically defined, although their meaning is not infrequently ambiguous, and one is left to infer the precise value of these terms from a perusal of the text.

To that considerable body of busy men whose responsibilities make it imperative that they shall keep in touch with the developments of this important subject, but whose scanty leisure gives them neither time nor opportunity for extensive study, this book should be very welcome. Medical officers and the medical profession generally, public analysts and chemists, bacteriologists, water engineers, gardeners, foresters, woodworkers, and those interested in sanitation, etc. are such, and although the book is primarily a scientific work, the mass of facts given must necessarily prove most valuable to many manufacturers and technical men.

F. R. O'SHAUGHNESSY.

PHYSICAL AND CHEMICAL CONSTANTS AND SOME MATHEMATICAL FUNCTIONS. By G. W. C. KAYE and T. H. LABY. Pp. 161. (London: Longmans, Green and Co. 1921.) Price 14s. net.

Kaye and Laby's "Physical and Chemical Constants" has gained so high a reputation as a book of reference on account of its general accuracy and the care shown by the authors in bringing it up to date that a brief reference to the appearance of a fourth edition will be sufficient. For this edition the chemical data have been recalculated, using the international atomic weights, and the tables of chemical constants have been carefully revised. In the Physics sections many of the heat tables have been revised and amplified and a number of other additions have been made. Although all the sections are good, that on Rays, Radioactivity and Gaseous Ionisation deserves special praise. Tables of characteristic X-ray spectra of the elements illustrate the marked advance in this subject within the last few years. The section on Chemistry occupies the same number of pages as that on Rays, Radioactivity and Gaseous Ionisation and is practically confined to tables of physical constants of a number of inorganic and organic compounds with two pages of data on solubilities.

GEORGE SENTER.

PUBLICATIONS RECEIVED.

DISTILLATION PRINCIPLES AND PROCESSES. By Dr. S. YOUNG and Collaborators. Pp. 509. (London: Macmillan and Co., Ltd. 1922.) Price 40s.

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PETROLEUM IN THE PUNJAB AND NORTH-WEST FRONTIER PROVINCE. By E. H. PASCOE. *Memoirs of the Geological Survey of India. Vol. XL. Pt. 3.* Pp. 331-493. (Geological Survey of India, 27 Chowringhee Road, Calcutta. 1920.) Price 7s. 6d.

RECENT WORK ON CATALYSIS AT SOLID SURFACES.

A growing number of chemical industries, and particularly those involving processes in which organic compounds are subjected to treatment, are based on the use of solid catalysts, which have thus become of considerable industrial importance. Obviously, an accurate knowledge of the fundamental nature and operation of catalysts is necessary for their employment to the best advantage, and fortunately it is possible to give an adequate basic explanation of many of these reactions in simple chemical language free from mathematical abstractions or elaborate terminology.

This was conclusively demonstrated at the meeting of the London Section on February 6, at which Dr. E. F. Armstrong delivered a lecture on the subject (which is here surmised), and illustrated the theoretical aspects of the question by some results of investigations, mainly on catalytic hydrogenation, which he has carried out in conjunction with Dr. T. P. Hilditch for some years past.

The range of application of such processes has become very extended, and latterly the field of interest has changed from hydrogenation and synthetic ammonia to catalyses involving oxidation, including those of ammonia, carbon monoxide, and, most recently, aromatic compounds. The last-named have received most attention from the Barrett Company, of New York, which produces malic acid and quinone from benzene, phthalic acid from naphthalene, anthraquinone from anthracene, etc.

Most industrial catalysts are solids, so that in order to obtain maximum opportunity of contact in promoting reactions either between liquids, liquids and gases, or gases, it becomes of outstanding importance to offer as large an extent of solid surface as possible.

There is a large variety of devices for increasing surface, from simple abrasion as practised by Elder to deposition on a suitable support. The subject of catalyst-supports must be considered with particular reference to the avoidance of poisons or anticatalysts, and the work of Maxted on the influence of various metals on the activity of metal catalysts may be quoted in this connexion.

The desirability of employing as low a temperature as possible in the preparation of a catalyst is largely connected with the coalescence or sintering of finely divided metals, a phenomenon which Wright and Smith have recently observed to take place in a number of cases very far below the actual melting point of the metal.

The most favourable conditions are, accordingly, preparation of the catalyst so that it presents the largest possible surface and maintenance of this surface in a "clean" condition, i.e., free from anticatalytic materials either in the material itself or in the liquids or gases to be treated. Slides were shown illustrating the effect of the apparent volume of a catalyst on its activity and the manner in which activity is concentrated in the surface layers of a solid catalyst.

Since refining of reagents is often relatively costly, a middle course is often dictated by economic reasons in technology; but when seeking to obtain an insight into the actual mechanism of the process it is of paramount importance to deal only with pure materials throughout.

Attempts have been made by different workers to formulate theories applicable to all cases of catalysis, but it is too early to postulate such a generalisation in view of the diversity of these reactions, and attention should be given for the

present to the collection of abundant data for each type, even though the resulting explanation might be restricted to a given class and of a tentative nature.

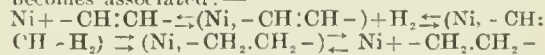
Sufficient facts have been accumulated in the case of changes induced in organic compounds by catalytic metals or metallic oxides to enable it to be asserted that the predominating influence is that between the organic compound and the catalyst.

Examples from the above-mentioned and other investigations illustrate this point, notably the observation of Dr. C. W. Moore that, during hydrogenation of olein, not only is stearic acid produced, but also two isomeric oleins, claidin, the geometrical isomeride of ordinary olein, and an iso-olein in which the ethylenic linkage is actually shifted to another position in the hydrocarbon chain.

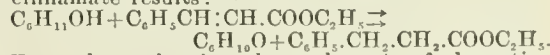
Another example is the curious behaviour of a doubly unsaturated compound such as an ester of linolic acid, which is hydrogenated to a mixture of oleates before the latter are appreciably attacked with formation of ethyl stearate, the rate of addition of hydrogen being characteristic and different for each stage.

Similarly, different but closely related catalysts show varying specific chemical actions. Thus, whilst ethylene is hydrogenated by nickel or copper, carbon monoxide is readily hydrogenated by nickel and not at all by copper. And again, carbon monoxide, when present as impurity in the hydrogen used for saturation of another compound, has a marked hindering effect in the use of nickel and little or none in the case of copper. Parallel with this, nickel forms a carbonyl derivative, and copper does not.

The simplest explanation in chemical language of these and similar data is to assume the formation of a loose intermediate additive compound of nickel and organic substance to which the hydrogen becomes associated:—



It should be possible, in harmony with this explanation, to transfer hydrogen from one compound to another in presence of nickel, and this has been done in some cases; thus when cyclohexanol, ethyl cinnamate and nickel are heated in an inert atmosphere at 180° C. an equilibrium mixture of these substances with cyclohexanone and ethyl hydrocinnamate results:—



From the authors' work on the rate of absorption of hydrogen during liquid hydrogenation it becomes apparent that, expressed graphically (hydrogen absorbed against time), the graphs are linear and not of the logarithmic-curve type associated with a unimolecular action, thus indicating that the measured action (the slowest of any sequence of any chemical changes proceeding) proceeds at a constant rate throughout. This was illustrated by slides showing the absorption of hydrogen by various oils, in which the dual nature of the action in the pre-olein and olein phases respectively was demonstrated.

In these instances approximate linearity is obtained, but when highly purified ethylenic compounds of a simple nature are employed (e.g., ethyl cinnamate or anethol) absolutely linear graphs express the course of all but the last 5 per cent. or so of the process.

The lecturer compared the "logarithmic" and "linear" types of action as follows: the former may be likened to a man loading bricks from a shed into a cart, the rate of loading becoming less as he is compelled to travel further for the bricks, whilst

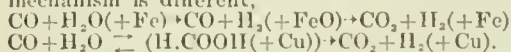
the linear action is represented by the bricks being fed on a moving band to the man who removes them at the same point all the time.

The results obtained are of the latter character and the constant rate of action measured is believed to be that at which hydrogen interacts with the assumed intermediate compound of nickel and organic substance.

The latter is probably not a definite substance to which a structure such as $\text{Ni} \begin{array}{c} \text{CH} - \\ | \\ \text{CH} - \end{array}$ can be

assigned; it may be produced by the interplay of subsidiary valencies, or be still less definite as in the absorption of a dye by a fibre: but the authors hold that their results are only explicable on the basis of association of some sort between metal and unsaturated centre due to the same chemical forces which operate in more ordinary chemical actions.

This view is further illustrated by the mechanism of the change $\text{CO} + \text{H}_2\text{O} = \text{CO}_2 + \text{H}_2$ in presence of iron and copper. With iron the action is one of alternato oxidation by steam and reduction by carbon monoxide, but this explanation can hardly be applied to copper, which is not oxidised by steam. Copper, however, has been shown by Sabatier to decompose formic acid into carbon dioxide and hydrogen at certain temperatures, and the authors have shown that the respective actions set in, in the case of iron, at about 350°C ., when the action of steam is known to commence, and in the case of copper at about 200°C ., the temperature quoted by Sabatier for the decomposition of formic acid. The confirmation afforded by the reaction-temperature data is strong evidence that, although the end-products are the same, the mechanism is different,



Finally, experiments in which the concentration (pressure) of hydrogen is altered during hydrogenation of a variety of organic compounds were described. With simple ethylenic compounds and normal concentrations of catalyst the rate is found to be directly proportional to the pressure, but at very low catalyst concentration it becomes less than simply proportional. The former fact proves that, essentially, the hydrogen added is in the molecular form. When unsaturated alcohols or acids are hydrogenated the acceleration of rate with increasing pressure is abnormally high, although the only actual chemical change effected is addition of hydrogen. The predominating influence of the organic compound undergoing change is particularly well illustrated by these experiments.

The lecturer referred to the changing physical conception of the nature of adsorption at a solid surface and observed that the single molecular layer view advanced by the late Lord Rayleigh, W. B. Hardy, and Langmuir (who regards adsorption as due to chemical forces) and the present "intermediate compound" explanation of catalysis are on converging lines of thought.

The outstanding work of H. S. Taylor, who is measuring the adsorption of inert gases, hydrogen and organic gases by catalysts such as nickel and copper, was reviewed on account of its extreme value in affording a prospect of experimental correlation of the phenomena of general adsorption and catalytic activity.

Discussion.

Prof. T. M. Lowry said that the authors' view that the ethylenic linkage attached itself to the metallic catalyst was in harmony with the results of Langmuir's experiments on the formation of unimolecular films of oil and water. It would be interesting to know if magnetic nickel, which

probably had a cube-centred cubic lattice, differed in activity from non-magnetic nickel in which the face-centred cubic lattice probably occurred.

Prof. J. C. Philip referred to experiments with charcoal in which it had been found that the activity increased as the bulk density decreased, *i.e.*, as the apparent volume increased. He was not convinced that the existence of a linear rate was proof of any particular conception of the action of the catalyst; it was possible to find a linear rate of reaction in a homogeneous system, *e.g.*, the rate of disappearance of iodine in presence of excess of acetone in aqueous solution. If the catalyst were present in very small amount compared with the active mass of the other reacting substances, the rate would be dependent on the capacity of the catalyst. If the catalyst were working at full capacity the concentrations of the other substances were immaterial provided these were either in large excess or kept constant.

Dr. R. W. Ormandy referred to the misleading character of much of the mathematical work on catalysis, and instanced the fact that a 95 per cent. conversion of methyl alcohol to formaldehyde was obtainable in practice—a figure which many physical chemists said was impossible. The conditions under which such work was carried out should be exactly defined. It would be interesting to see if catalytic substances reduced to a very fine state of subdivision by means of the Plauson mill showed an increase in activity proportional to the increased surface. In regard to sintering, he mentioned that the sintering temperature of clay could be reduced several hundred degrees by removing one or two per cent. of foreign material, and also by reducing to a fine state of division. In all probability the addition of a small amount of foreign material to a catalyst would increase its sintering temperature. In some work with Mr. Craven he had found that certain substances were capable of absorbing a foreign material on a portion only of the surface, whilst it was possible to absorb other types of material at the remainder of the surface: that pointed to local selective ability.

Prof. H. E. Armstrong recalled the fact that C. O'Sullivan and Thomson in their work on the hydrolysis of cane sugar by invertase had been so impressed by Harcourt and Esson's work that they had jumped to the conclusion that the rate was logarithmic, although the data, properly interpreted, were indicative of a linear course. The work described in the present paper was, in his opinion, the clearest possible confirmation of the conclusions previously drawn as to the nature of enzymic interactions, particularly as manifest in the hydrolysis of urea by urease. The linear character of the change, almost to the very end, when secondary effects were controlled, would not be met by arguments such as Dr. Philip had used.

Mr. Arnold Philip referred to his work on the determination of combustible gases in air by means of a Wheatstone bridge with arms of palladium or platinum wire; the wires had been "ripened" by heating in a mixture of combustible gas and air, and it had been found that the lower the temperature used the greater was the catalytic activity of the wires.

Mr. A. L. Bloomfield considered that what was required was not less mathematics but more careful mathematics. The authors appeared, on the basis of a straight line curve, to have put forward a chemical theory for the reaction. He suggested that what the authors had really been measuring was not the rate of change of the addition compound, but the rate of solution of the hydrogen.

Dr. Hilditch, referring to Dr. Philip's suggestion, said that if the catalyst was working at full capacity, it seemed to him that it could not

respond to any further increase, and he did not see how they could have got their results. If the pressure and concentration of hydrogen were doubled the rate of reaction was doubled, and if the catalyst was working at full capacity, it should not be affected at all. On the other hand, in the case in which they had worked with exceedingly small proportions of catalyst, there was definite evidence that the catalyst was working to some extent approaching full capacity, but so long as there was at least one part of nickel per thousand of the unsaturated compound, it was possible proportionately to increase the rate of reaction by increasing the concentration of the hydrogen; that showed, in his opinion, that the nickel was not working to its full capacity because it took advantage of the extra concentration of hydrogen. With regard to Mr. Bloomfield's remarks, the authors believed that their theory did have some relation to chemical facts. For instance, nickel would hydrogenate ethylene and carbon monoxide and formed a definite compound with carbon monoxide, whereas copper attacked ethylene but not carbon monoxide. There were numerous other instances which showed that their theory was at least compatible with chemical behaviour.

Mr. W. B. Clarke referred to the difficulty of obtaining hydrogen sufficiently pure for the preparation of pure specimens of nickel, molybdenum, tungsten, and other metals.

Dr. Armstrong said that they had accumulated a considerable amount of evidence in favour of what might be called space orientation of molecules at catalytic surfaces, but it was at present of a very speculative character. Referring to Mr. Bloomfield's suggestion that they had merely been measuring the rate of solution of the hydrogen, he thought that the facts that in some cases as much as 70 litres of hydrogen had been absorbed in 150 grams of oil in 25 minutes, and that the rate of absorption varied specifically with the type of organic compound, were obviously against such an interpretation.

THE SYNTHETIC MANUFACTURE OF VANILLIN.

Vanillin, the odorous principle of the vanilla bean, is manufactured to-day in large quantities, chiefly by oxidising iso-eugenol with ozone. The production in the United States is shown by the Census of Industrial Products to have been 134,700 lb., valued at \$1,365,900 in 1919. The ozone oxidation-process is also extensively practised in this country.

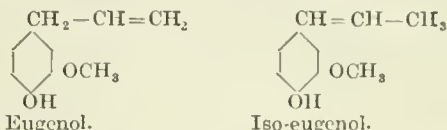
Vanillin is largely used in the production of perfumery, and its application is steadily increasing. It finds a place in many high-class bouquet perfumes and as a constituent of soap perfumes. As a flavouring agent for chocolate and confectionery, however, it is by no means generally employed in place of extract of vanilla beans. Although the claims of the "artificial" product have been extensively advocated, particularly by producers of vanillin, experts in flavouring essences are still conservative. Whether this attitude is justified or not—controversy is still rife upon the subject—the facts cannot be overlooked. Thus, the best qualities of vanilla beans (Mexican) command a price of about 24s. per lb. in the open market, whilst other varieties can be purchased for a quarter of this sum. Vanillin, on the other hand, can be bought at 36s. per lb., i.e., at one and a half times the price of the beans, which possess one-fiftieth of the flavouring

power. It is noteworthy that the best qualities of vanilla beans contain less actual vanillin than the cheaper qualities of beans.

Vanillin from Eugenol.

The original preparations of vanillin from coniferin and coniferyl alcohol, and from eugenol by oxidation (*cf.* Erlenmeyer, *Ber.*, 9, 273), led the way to numerous processes for the practical utilisation of the oxidative method on a large scale. Many patents were taken out between 1880 and 1900 which covered the use of practically all kinds of oxidising agents, *e.g.*, potassium permanganate in alkaline and in acid solution, potassium dichromate in acid solution, chromic acid, and manganese dioxide and acid.

A substantial advance was made when eugenol was first converted into iso-eugenol, and the latter then oxidised. Eugenol is easily converted into its isomer by heating with solid caustic potash.



An improvement was, however, effected by De Laire (*Eng. Pat. No. 17,547 (1890)*), who heated eugenol, dissolved in amyl alcohol, with potash for about a day, removed the amyl alcohol by steam-distillation, and after washing obtained the iso-eugenol by distillation.

Greater yields of vanillin are obtained when a derivative of iso-eugenol is oxidised. The hydroxyl group is protected by forming the acetyl, benzoyl, or other derivative, by the action of the corresponding anhydrous acid, or by the action of the acid chloride upon the alkali salt of iso-eugenol. The preparation of the derivatives must be so conducted that little polymerisation occurs, since the polymerised products do not give derivatives of vanillin on oxidation. The oxidation may be carried out according to any of the usual oxidising methods; one process, claiming to give excellent yields, makes use of chromyl chloride as oxidising agent, acetyl-eugenol being used as starting material.

The protection of the hydroxyl-group of eugenol has been effected by means of inorganic acids as well as organic acids. Phosphorus oxychloride reacts with eugenol to give the phosphoric-acid derivative, which on treatment with potash yields the corresponding iso-eugenol derivative, and this is easily oxidised to the vanillin derivative.

Haarman and Reimer, whose studies upon the oxidation of eugenol are well appreciated, were granted two patents (*Eng. Pat. Nos. 11,952 (1894) and 14,928 (1896)*), in which sodium peroxide or other substance giving oxygen in the presence of alkali was to be used for oxidising iso-eugenol, the latter being added either to a cold aqueous solution of sodium peroxide, which was then brought to the boiling-point, or to a boiling alcoholic solution of the peroxide. After acidifying, the vanillin was recovered by extracting with ether.

Electrolytic oxidation was proposed by Dornson in an English patent (*No. 1624 of 1895*), which specified the use of an alkaline solution of iso-eugenol in the anodic compartment, and of a 20 per cent. alkaline solution in the cathodic compartment; oxidation was effected at 60° C., and the vanillin recovered by acidifying and extracting.

The above processes have only received brief mention because they have no practical value to-day. The continuous efforts to discover an oxidising agent for iso-eugenol or a derivative which would afford a good yield of vanillin had relatively little success until the discovery of the ozone method, which gives a very clean oxidation.

The Use of Ozone.

The use of ozone as an oxidising agent in practical operations became possible about the beginning of the present century, when large ozonisers, mainly of the silent-discharge type, were constructed capable of producing the gas in comparatively high concentration—2—3 grams per cb. m. of air passed—and at a low cost in electrical power. Having proved their value in the sterilisation of water on a large scale, such ozonisers were adopted for the oxidation of iso-eugenol. Earlier attempts to effect such oxidation by means of air previously passed through oil of turpentine had met with little practical success.

The process of the Ozone Vanillin Co., of the United States (U.S. Pat. No. 829,100), consists in passing ozonised air into a mixture of iso-eugenol and sodium bisulphite solution of 30° Bé. The vanillin produced unites with the bisulphite, and is so removed from the sphere of action; the yield is excellent and the vanillin easily separated from the bisulphite compound. A similar process can be used to produce heliotropin and anisaldehyde from isosafrol and anethol, but in these cases a more dilute solution of bisulphite must be employed, as the bisulphite compounds of heliotropin and anisaldehyde are less soluble than that of vanillin.

It has also been suggested (Fr. Pat. No. 421,784) that the iso-eugenol should be dissolved in a solvent with a high boiling-point, such as toluene or ethylbenzene, and subjected to the oxidising action of ozone. Less resinous matter is stated to be formed and better yields of vanillin obtained than when iso-eugenol is employed in aqueous emulsion.

Harries states (Ger. Pat. No. 321,567) that the ozonides of iso-eugenol are reduced with better yield if treated in acetic-acid solution with potassium ferrocyanide; little or no resin is formed and vanillin is recovered in 95 per cent. yield.

The advantages of the use of ozone are many and obvious. The paramount question is that of yield, which in the ozone process is very high and greater on the large scale than in the laboratory.

It is convenient here to notice the process suggested by Genthe and Co. (Ger. Pat. No. 224,071), which to the writer's knowledge has not been applied successfully in large-scale operation. The oxidation of eugenol was to be effected by means of air in the presence of ultra-violet rays. The air was to be passed through the pure eugenol or a solution of eugenol, maintained at 50°—60° C., and the yield of vanillin was stated to be as high as 95 per cent.

Before leaving this section, a new source of eugenol may be noted, together with a new method of effecting isomerisation. The oil obtained from Jamaican pimento leaves contains a relatively high proportion of eugenol (*cf.* J., 1921, 13 R), and, under certain conditions of fermentation, the leaves yield an oil containing a large percentage of iso-eugenol. It has been reported that 893 grams of the crude oil gave on distillation 561 g., or 63 per cent. of iso-eugenol, and 272 g., or 30.6 per cent., of eugenol. The prospects of producing vanillin cheaply in Jamaica are considered excellent.

Vanillin by Synthesis.

The methylation of protocatechuic aldehyde, and the introduction of an aldehyde group into the molecule of guaiacol, show clearly the possibility of obtaining vanillin by synthesis; but either method is impracticable for technical purposes unless a cheap methylating agent be available. Such a reagent allows of the preparation of synthetic guaiacol from phenol.

Again, for the successful application of synthetic methods in technical practice, better methods of

introducing an aldehyde group have had to be found. Reimer's method in which chloroform and alkali are caused to react with guaiacol (Ber., 9, 425) gives small yields. The use of hydrochloric and hydrocyanic acids with zinc chloride (Ger. Pat. No. 189,037) is unsatisfactory for large-scale work because (*inter alia*) of the difficulty of preparing the required concentration of hydrocyanic acid and of its poisonous nature. The reaction between guaiacol, carbon monoxide and hydrochloric acid, in the presence of copper chloride, is unsuccessful in practice. Further, the method of Guyot and Gry (Compt. rend., 1909, 149, 928) cannot be carried out on a large scale. The use of dihydroxysuccinic acid or of dihydroxytartaric acid, in the presence of sulphuric acid, is clearly excluded as an economic process for producing vanillin. By the condensation of formaldehyde with guaiacol, in the presence of hydroxylaminobenzenesulphonic acid—easily produced *in situ*—vanillin has been made on a technical scale, and this new method, of which there are several modifications, will be described more fully later. If, therefore, guaiacol can be obtained synthetically, and at a low production cost, synthetic vanillin can be manufactured.

Gattefossé and Morel (Parfum. Mod., 1919, 114) describe plant for carrying out the following series of reactions:—

Phenol → (A) o-nitrophenol → (a) o-nitroanisol → (c) o-aminoanisol → (v) guaiacol (by diazotisation and -OH formation) → (E) vanillin.

(A) The nitration of phenol, with the production of the ortho- and para-derivatives, is easily performed, and the separation of the two isomers by steam-distillation is simple and complete. Para-nitrophenol is extensively used to yield, by reduction, the amino-derivative, which is employed in photography and in the preparation of the phenetides.

(a) For the methylation of o-nitrophenol, dimethyl sulphate is employed. This substance is comparatively easily prepared by the following method:—Anhydrous methyl alcohol is dissolved in the inert diluent, carbon tetrachloride, in the proportion of 7 : 20. On treatment in the cold (–50° C.) with oleum containing 60 per cent. SO₃, monomethyl sulphate is produced and separates from the carbon tetrachloride, which is unattacked by the acid at the low temperature of operation and can be re-used. The monomethyl sulphate is distilled in a vacuum of 15 mm., whereupon dimethyl sulphate is produced with formation of sulphuric acid. The former is separated and quickly washed with cold water. The dimethyl sulphate may be re-distilled; it boils at 150° C., under 15 mm. pressure.

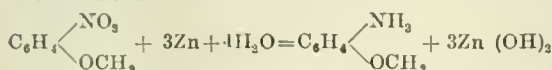
Dimethyl sulphate produced in good yield and at a relatively low cost, is added to a solution of nitrophenol in caustic soda. The mixture is agitated energetically and the temperature is not allowed to rise above 50°—60° C. The nitroanisol produced is a heavy oil, easily separated from the methyl alcohol and sodium bisulphate formed in the reaction. On washing with sodium hydroxide, any nitrophenol which has escaped methylation—usually only 1—3 per cent.—is removed and re-used in the process, whilst the nitroanisol is passed on to the reduction stage.

It may here be noted that as early as 1900 Sommer patented the use of dimethyl sulphate, in the presence or absence of alkali, for the methylation of protocatechuic aldehyde—vanillin being, of course, produced. (Ger. Pat. No. 122,851.)

A recent method (Blom, Eng. Pat. No. 167,582) for the manufacture of nitroanisol is of interest. Ortho-nitrochlorobenzene is used as starting material, and is condensed with methyl alcohol. The acid liberated is neutralised with alkali, pro-

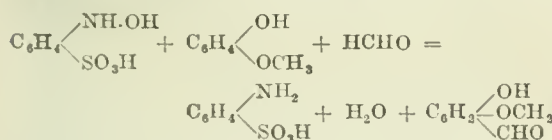
duced *in situ* by the interaction of lime and sodium carbonate. In this way undesirable subsidiary reactions, which occur when excess of free alkali is present, are avoided.

(c) *Anisidine*.—The reduction of *o*-nitroanisol is carried out by means of zinc powder and water. The reduction proceeds more quickly in the presence of calcium chloride (Bamberger's process), and discoloration and formation of di-anisidine, such as occur when iron and hydrochloric acid are employed, are avoided. The nitroanisol is added to a solution of calcium chloride in the amount of water theoretically required for the reduction, and the zinc powder is slowly added to the boiling solution. After cooling, the reduced product is extracted with benzene.



(d) *Diazotisation and Guaiacol Formation*.—The diazotisation is easily effected in the ordinary manner, the reaction being followed by means of "starch-iodide" paper. The elimination of free nitrogen and the formation of guaiacol proceed normally, but the temperature must be raised to 135° C. on account of the stability of the diazo-anisidine sulphate. Sodium sulphate is therefore added to the acid solution of the diazo-sulphate, and the boiling-point of the solution thus raised to the required temperature. The guaiacol produced is distilled in steam.

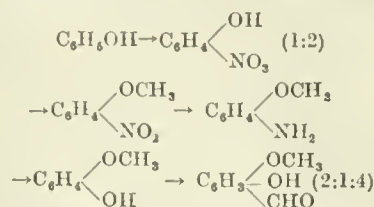
(e) *Introduction of the Aldehyde Group into Guaiacol*.—When a mixture of guaiacol, formaldehyde and hydroxylaminobenzenesulphonic acid is heated, the aldehyde group is introduced into the guaiacol molecule, and vanillin is formed.



The hydroxylaminobenzenesulphonic acid is produced *in situ* by the reduction of nitrobenzene sulphonic acid, which is easily obtained by sulphating nitrobenzene with oleum (15% SO_3) at 100°–130° C.; the reaction is complete when total solubility in water results. The acid solution obtained is mixed with the required quantities of guaiacol and formaldehyde, and iron is added. The above reaction then takes place, and when it has finished the vanillin is recovered by extracting with ether. The ethereal solution is treated with sodium-bisulphite solution, whereby the bisulphite compound of vanillin is taken into aqueous solution, any guaiacol which has been unacted upon remaining in the ether and being re-used. The vanillin-bisulphite compound is decomposed with 50 per cent. sulphuric acid, and the vanillin is extracted and purified, if necessary. In the above reaction, it is stated that the sulphonic acid of nitrotoluene gives better results than the benzene derivative, less tarry matter being produced.

Essentially the same method of introducing the aldehyde group into the guaiacol molecule has been patented by the Société Chimique des Usines du Rhône (Eng. Pat., Nos. 161,679 and 164,715). The condensing agent is nitrosobenzene, nitrosophthalene, or nitrosodimethylaniline. Thus, a mixture of guaiacol and formaldehyde is dissolved in methyl alcohol and dimethylaniline is added. On treatment with nitrous acid, the nitroso-derivative of dimethylaniline is produced and effects condensation, as fully described above in the case of hydroxylaminobenzene sulphonic acid. The method can also be applied using hydrochloric acid as solvent.

The transformations effected in the production of vanillin from phenol may be represented, therefore, as follows:—



The economical utilisation of the rather complex series of reactions became possible during the war on account of the rise in price of the vanillin produced from eugenol, which was used for new purposes, *e.g.*, in "dopes" for aeroplanes, and so became scarce. The future of synthetic methods depends mainly upon the cheapness of the original raw materials. If *o*-nitrophenol can be obtained at prices that ruled during some periods of the war, the full synthesis of vanillin should be commercially practicable, even in competition with the better-known and proved methods which use eugenol as the starting material.

THE SAFEGUARDING OF INDUSTRIES ACT.

DISCUSSION BY NEWCASTLE SECTION.

Following the example of the Nottingham Section, the Newcastle Section has held a meeting to discuss the precise signification, if any, of various terms used in the Act, the ambiguity of which is proving to be the cause of so many costly legal actions. Dr. J. H. Paterson presided at the meeting, which was held on February 2.

"*Chemical*."—Prof. W. N. Haworth opened the discussion by pointing out that in an attempt to define such terms as *chemical*, *fine chemical*, *manufactured*, *organic*, *synthetic*, *derivative*, it would be fruitless to introduce ideas foreign to the spirit of the Act itself or which were too rigidly scientific or literal in expression. They should attempt to frame expressions which would leave but a narrow gateway admitting such products as the Act intended should come under the observation of the Customs officials. Even such a question as "What is a chemical?" was open to the most diverse answers. Although to the chemist calcium carbonate was a chemical, what were they to say if asked to include limestone and marble in that category? And if marble, then why not granite—whether building blocks or gravestones? Similar difficulties would arise with brewing and distilling. They were chemical industries, and the materials used should be considered as chemicals; but should they subject maize and barley to a tax of 33½ per cent.? And if barley, why not flour? The same difficulties arose in artificial-silk manufacture. Iron smelting, too, was a definite chemical process, yet were iron ore and metallurgical coke chemicals? Foodstuffs were, fortunately, exempt. The use of petrol as a fuel in the internal-combustion engine involved a definite chemical change. Petrol was organic, and organic chemicals were included under the provisions of the Act. An attempt would have to be made to steer a clear course, avoiding extravagances which might be imposed by broad, general definitions and yet to draw a net wide enough, and only just wide enough, to catch those substances broadly known as chemicals, which common

sense indicated were of the kind intended to be brought under the operation of the Act.

Prof. H. V. A. Briscoe said that the term chemical was basic to a number of other terms which followed in the line of discussion suggested. To be frank, he did not think they could define the other terms in any exact sense of the word "define." Essentially a definition must be simple and take in a large proportion of the facts. To frame a definition in that sense was going to be extremely difficult in the case of "fine chemical." The definite character of chemical change was the primary consideration. Chemical change might be defined with considerable accuracy. First, one must define "substance." A substance was a homogenous material or article which was characterised by a certain definite set of properties. Chemical change was a change in which one or more substances were abruptly altered (and the abruptness of the change was an essential feature) into one or more different substances, the change being accompanied by loss or gain of energy. Such a definition was, however, open to criticism. A chemical he would define provisionally as something produced by and used in producing chemical change; but it appeared to him that the more daylight they got on the subject the more difficult they would find the task set them.

Dr. J. H. Paterson intimated that they would discuss the terms *seriatim*, and the first would be the word "chemical." It seemed to him important at the outset to understand that it was almost impossible, under the circumstances, to discuss the terms from a purely scientific standpoint. The Act itself was devised to protect certain industries, or to encourage certain industries by making it possible to manufacture more profitably than when free import was allowed; and the discussion must proceed with that point in mind.

Prof. H. Louis said he had observed in the last number of the *Review* that the Nottingham Section had set up a series of definitions, and he heartily disagreed with every one of them, particularly regarding the question of the source of the substance. Prof. Haworth had mentioned carbonate of lime and limestone. He could give them many others. He did not regard magnesite for furnacelinings as a chemical, but he held that magnesium carbonate was one. He believed that the source of the substance was an essential point. It mattered a great deal whether a substance was a natural substance or a manufactured substance. Then, again, it was difficult to define "manufacture." There was an objection to defining chemicals by the use of the word "chemical." No one would call spelter a chemical, yet when used for brass manufacture, it entered into combination with copper, which produced an abrupt change in the properties of both metals. He was clear on one point, viz., they must exclude naturally-occurring mineral substances. His feeling was that it would be absolutely impossible to lay down any strict scientific definition that would hold good. He had been up against the somewhat similar problem of "What is a mineral?" One judge (Lord Halsbury) had said that when the word "mineral" was used it had the significance attached to it "in the vernacular of the mining world, the commercial world and landowners." That, he thought, was the sound way of looking at the present problem. They must attach the meaning to it which people did, who understood and dealt with the material. In deciding such knotty points he thought it was impossible to proceed by strict definition. The only way was to empanel a certain number of chemical manufacturers—as far as possible disinterested in the article under discussion—and get them to say what the word meant. Some things were very clear, but others were on the borderline. Apart

from natural minerals, he thought it impossible to make any strict definition.

Dr. G. Weyman agreed with Prof. Louis that it was practically impossible to get a definition. In the first place he did not think the word "chemical" was properly a noun, but an adjective; it had a tendency when used as a noun to include everything under the sun. He thought it should be interpreted in the way in which the people who framed the Act intended it should be applied. He understood that the object was not to tax raw material, but finished products. Obviously they did not want to tax raw material, but there was the difficulty that what might be raw material to one might be a finished product to another. The only solution was to consider the value per ton, or rarity. He would suggest that a limit of, say, £200 or £300 per ton value be placed on a substance which was not a raw material.

Prof. Haworth then put forward the following definition:—"A chemical substance is a substance both made by and used to produce a chemical change which is not a naturally-occurring ore or mineral and which may be a plant or animal substance."

In the course of a long discussion Prof. Briscoe said that if they gave any definition they would put themselves in a false position. He felt strongly that the Government had got itself and the whole country into a hole owing to neglect to take expert opinion beforehand, and the general body of chemists was expected to come to the rescue. If the body of chemists as a whole stretched its conscience and made definitions, which as they could see were tending to square with the Act, they would put themselves in the position of assuming a responsibility which really rested with the people who made the first mistake. They should bear that in mind before putting in writing any hard and fast resolution.

Dr. P. E. Bowles said that they should formulate a perfectly pedantic and academic definition, and if the materials did not come into line their importation should be stopped. They would be on sure ground in the future if they made a strictly academic definition. The introduction of such a factor as price would bring in fluctuations that would invalidate a scientific definition.

The Chairman said he was inclined to agree with Dr. Bowles, but he thought that they had to consider the policy intended by the Act; perhaps the simplest way would be to pass a resolution to the effect that it was utterly impossible to discuss those terms as they related to an Act, but that would be of no benefit.

Prof. Briscoe said the definitions of chemistry were clear, and chemists themselves were clear about them, but in working practice they did not attempt to define a boundary line between organic and inorganic chemistry. Certain products were extremely clearly defined, but others were just on the borderline. They were attempting that even-
ing to draw an impossible borderline.

Eventually the following resolution, moved by Prof. Louis and seconded by Prof. Briscoe, was carried unanimously:—"For the purpose of the Act all ores or minerals should be excluded from the definition of the term chemical."

"*Fine Chemical.*"—Prof. Briscoe said that as "chemical" had not been defined they could not define "fine" chemical; but he would suggest one or two lines of guidance with regard to "fine." It conveyed to him at least one of two things—a degree of rarity and a degree of purity. A substance might be rare and not pure, and still be a fine chemical; and a substance which was quite common might be extremely pure and not considered a fine chemical. It would be difficult to exclude sodium bicarbonate, which was ex-

tremely pure but quite common. If they were to have a definition they would be faced with the further difficulty of having to draw a line among the degrees of purity and rarity. He felt it was even more impossible than defining "chemical." One might arrive at a coherent definition of chemical, but the degrees of purity and rarity seemed to him extremely difficult of definition.

Prof. Haworth moved that they agree "that the word 'fine' as used in the term fine chemicals implies a material which has been subject to careful refinement and purification, and which, ordinarily, is used in comparatively small amounts or is so rare as to constitute a fine chemical even though it may contain impurities." Dr. G. Weyman seconded, and this was carried with little discussion.

"*Manufactured.*"—Prof. Louis pointed out that they had not actually defined the term chemical, and it seemed unnecessary to define the word "manufactured" as applied to chemistry.

Dr. Bowles moved: "That the term 'manufactured,' as applied to chemical substances, does not need definition." Prof. Briscoe seconded, and this was carried.

"*Organic chemical.*"—Opening the discussion, Prof. Haworth referred to the old view that a sharp distinction lay between the organic and the inorganic. Since then, the borderland between the two terms had very much widened, and now it was almost impossible to draw a line of demarcation. There was a whole mass of commercial substances which could not be classified as one or the other. An eminent K.C. had been trying to discover from eminent chemists whether calcium carbide was organic or inorganic, and he had found chemical authorities of high standing supporting both views. Therefore it could be said that already in scientific thought the sharp distinction had disappeared, and it was merely retained for purposes of convenience and not because it was strictly scientific. All they could hope to do was to attempt to assist people who were in a difficulty by suggesting that an organic substance must contain carbon as an essential constituent. He moved: "That an organic chemical may be said to be a substance containing as an essential of its composition carbon, including as chemicals vegetable and animal substances, as well as many elaborated by artificial means, provided they contain carbon, and excluding metallic carbides and metallic cyanides as being among the most important exceptions to this generalisation." After discussion, Mr. Hirsch seconded this definition, and it was agreed to.

"*Synthetic chemical.*"—Prof. Haworth said that in the narrow scientific sense the term meant the building up of substances, but already in practice they frequently included substances which had not been prepared by the attachment of carbon to carbon but by the separation of carbon from carbon. In fact, they confused the terms "synthetic" and "artificially prepared." For the purpose of the Act it would appear that the confusion was to remain. He suggested the following definition:—"A synthetic organic compound or synthetic organic chemical is identical with an organic chemical occurring in plants or animals, which has been artificially produced by a chemical change and/or an organic chemical artificially prepared, resembling and related to those occurring in plants and animals." Mr. Binks seconded, and this definition was carried unanimously.

"*Derivative.*"—Prof. Haworth said that in discussing this term it was essential to consider it from the point of view of the intention of the Act. He did not propose to deal with it at length, and regretted that he had found it impossible to suggest a definition which would not have an economic appearance. He moved, as an attempt at a definition for the purpose of the Act:—"A derivative

is a transformation product of a chemical from which the said chemical may be recovered at a cost not exceeding the duty on it; or a transformation product of a chemical which can be prepared from the said chemical at a cost not exceeding the duty on it."

Prof. Louis said he could see no way of avoiding the mention of cost in any definition they might give of that term, and Mr. Dunford Smith suggested that fluctuating prices and rates of exchange were both factors which left loopholes in that definition. Prof. Haworth and others agreed that it would not be possible to prevent speculation in some shape or form. Fortunately they were not called upon to deal with that, but to make definitions which would be as workable as possible in accordance with the intention of the Act. Prof. Briscoe seconded the definition, and it was carried.

The Chairman proposed a hearty vote of thanks to Professors Haworth and Briscoe, who, he understood, had collaborated in preparing the openings for discussion. Without their guidance they would have been completely at sea.

REVISION OF GENERAL RAILWAY CLASSIFICATION FOR MERCHANDISE BY GOODS TRAIN.

(Excluding Dangerous Goods.)

The cost of conveyance by rail of chemical commodities is of such importance to the industry that no apology is needed in laying before our readers from time to time items of news and records of recent developments connected with this subject. The value of concerted action in placing before the authorities concerned representations on behalf of the chemical trade with the object of securing reductions in cost and equitable conditions of treatment, is shown by the success of the energetic action taken by the Association of British Chemical Manufacturers, advised by its Traffic Committee, of which Mr. J. Lukes is chairman, and by its Transport Manager, Mr. A. J. Malacrida, to whom we are indebted for the following information.

In the early part of 1921 the railway companies issued their Provisional Proposals for the carriage by goods-train of merchandise other than dangerous goods, and an opportunity was given to traders to consider them and, if deemed necessary, to lodge objections with the Rates Advisory Committee. After careful examination of the proposals, the Association of British Chemical Manufacturers sent in various objections, but in order to facilitate the work of the Committee it was decided that, before they were considered by it, representatives of the railway companies and the traders should hold a conference to ascertain if agreement could be reached on any of the matters in dispute. As the result of three meetings held in November last some valuable concessions were obtained, but as, in the opinion of the traders, these concessions represented only a small fraction of those which they demanded, the items in dispute were left for the consideration of the Rates Advisory Committee.

At three meetings of the Committee held early in February, 1922, the Association of British Chemical Manufacturers submitted about twenty items for adjudication by the Committee. Evidence was given by Mr. J. Lukes (Brotherton and Co., Ltd.), Mr. J. H. Fitton (British Dyestuffs Corporation, Ltd.), Mr. W. F. Fern (United Alkali Co., Ltd.), Mr. Page (Boake, Roberts and Co., Ltd.), Mr. G. W. Smith (Boots, Ltd.), Mr. H. Wippell Gadd (The Drug Club), and Mr. A. J. Malacrida; and

after very careful consideration the Rates Advisory Committee granted fifteen of the concessions demanded. It is, of course, very difficult to assess the value of these concessions at the present time, but this will be possible after the new classification and the new rates come into operation at a date to be appointed in accordance with the provisions of the Railways Act, 1921.

The following list shows the proposals put forward by the railway companies together with the traders' counter-proposals and the decisions which have been reached, either as the result of the negotiations with the railway companies or by the Rates Advisory Committee:—

Traffic.	Railway Companies' Proposal.	Traders' Proposal.	Committee's decision.
Copper Sulphate— In sound casks or cases in strong closely woven bags for export in 10-ton lots	.. Class 13	.. Class 7	.. Class 10.
Brine— In o.t.w.	.. Class 4	.. Class 1	.. Class 2.
Nitre Cake	.. Class 8	.. Class 8 C.W. .. Class 3 O.W.	.. Class 8 C.W. .. Class 5 O.W.
Chetolicals e.o.h.p.	.. (Railway Companies' Proposal maintained.)	.. (Traders' Proposal maintained.)	.. (Railway Companies' Proposal maintained.)
Fruit Salts	.. (Railway Companies' Proposal maintained.)	.. (Traders' Proposal maintained.)	.. (Railway Companies' Proposal maintained.)
Bark, Quilla	.. Class 18	.. Class 9	.. Class 13.
Dye extracts and dyes.	.. (Railway Companies' Proposal maintained with addition of word "colours.")	.. (Traders' Proposal maintained with addition of word "colours.")	.. (Railway Companies' Proposal maintained with addition of word "colours.")
Alkali list— In casks, iron drums or sacks	.. Class 8	.. Class 8	.. Class 8. With addition of cases and boxes.
Calcium Chloride of— Solution	.. Class 8	.. Class 2 c.	.. Class 6.
Lithopone	.. Class 11	.. Class 8	.. Class 11.
Gas-water or gas-liquor	.. Class 2	.. Class 1	.. Class 1.
Tar, coal or gas— O.t.w.	.. Class 2	.. Class 1	.. Class 2.
Casks or iron drums	.. Class 6	.. Class 6	.. Class 6. 4 tons. .. 5 tons.
Cresote, Coal-tar— In o.t.w.	.. Class 8	.. Class 1	.. Class 4
Casks or iron drums	.. Class 10	.. —	.. Class 8.
Pitch, Coal-tar	.. Class 6	.. Class 2	.. Class 6.
Anthracene, crude— In o.t.w.	.. Class 11	.. —	.. Class 10.
Anthracene e.o.h.p.	.. Class 19	.. Class 10	.. Class 10.
Anthracene Oil— O.t.w.	.. Class 8	.. Class 1	.. Class 7.
In casks or drums	.. Class 10	.. —	.. Class 10.
Naphthalene e.o.h.p.	.. Class 13	.. —	.. Class 11 C.W. .. Class 10 O.W.
Carbonate of lime waste— In bulk	.. Class 5	.. Class 1	.. Class 2.
Packed	.. Class 7	.. Class 5	.. Class 7.

REVISION OF GENERAL RAILWAY CLASSIFICATION.

GROUP 9.—CHEMICALS.

List of Amendments in Provisional Classification offered by the Railway Companies to Traders and accepted by them.

As in Provisional Classification.	Classification as offered and accepted by Traders.
Ammonia, Carbonate of— In casks or iron drums	Ammonia, Carbonate of— In cases, casks or iron drums
.. 15	.. 13
In tins in cases	.. 18
.. 16	.. 19
In cases	.. 19
In stone jars	.. 9
Brimstone or sulphur (When loaded loose must be sheeted.)	Brimstone (as Sulphur).
Calcium Sulphhydrate of— Solution, in o.t.w. 8-ton loads, owner's risk	Calcium Sulphhydrate of— Solution, in o.t.w. 8-ton loads
.. 10	.. 7
Calcium Nitrate of, solo— In o.t.w. 8-ton loads, owner's risk	Calcium Nitrate of, solo— In o.t.w. 8-ton loads
.. 10	.. 7
Chemicals, as under— (<i>Vide</i> pp. 40 and 41.)	Chemicals, as under, etc.— (Added to list of chemicals <i>vide</i> pp. 40 and 41.)
Potash, Caustic, solid	Caustic potash, solid.
.. 13	Soda, Acetate of.
Soda, Acetate of	.. 13
Soda, Nitrate of, in casks	Soda, Nitrate of.
.. 13	Soda (washing soda crystals).
Soda	

Chemicals e.o.h.p.—
(*Vide* p. 41.)

Note.—Jars and carboys exceeding 7 galls. capacity not accepted.
Drugs, not dangerous, corrosive or explosive, etc., *vide* p. 55.

Note.—Carboys and jars exceeding 7 galls. capacity not accepted.

Fleshings and glue pieces—
Wet, in casks or sacks

Wet e.o.h.p. (not handled unless packed) .. 11

Dry, in bales, casks or sacks .. 12

Glue, Fish .. 13

Glue, liquid—
In tins, bottles, or collapsible tubes, packed in cases .. 18

Lead Chromate .. 10

Manure, packed, e.o.h.p.—
i.e., any substance for use as manure without undergoing any further preparation, and so con-

signed) .. 7

Mastic .. 18

Naphthalene, crude (creosote salt)—
In owners' wagons, 8-ton loads o.f.

Note.—Creosote salt when in sacks or in bulk is conveyed in owners' wagons only, which must be covered with owners' sheets.

Ore, Purple .. 2

Ore, Purple, compressed into briquettes .. 2

Ore, Sulphur .. 6

Pyrites, iron, burnt .. 2

Sulphur .. 9

(When loaded loose, must be sheeted.)

Chemicals e.o.h.p.—
(*Vide* p. 41.)

Note.—Jars and carboys exceeding 10 galls. capacity not accepted.
Drugs, not dangerous, corrosive or explosive, etc., *vide* p. 55.

Note.—Jars and carboys exceeding 10 galls. capacity not accepted.

Fleshings and glue pieces—
Wet, in casks or sacks

Wet e.o.h.p. .. 10

Dry, in bales, casks or sacks .. 12

Glue, Fish .. 15

Glue, liquid—
In tins, bottles, or collapsible tubes, packed in cases .. 15

Lead chromate .. 15

Manure, packed, e.o.h.p.—
(i.e., any substance for use direct as manure or any manure substance to be mixed and used as manure, and so con-

signed) .. 7

Mastic-resin .. 18

Naphthalene, crude (creosote salt)—
In owners' wagons, 8-ton loads

Note.—Creosote salt when in sacks or in bulk is conveyed in owners' wagons only, which must be covered with owners' sheets.

Ore, Purple .. 1

Ore, Purple, compressed into briquettes .. 1

Ore, Sulphur. To be deleted.

Pyrites, iron burnt (pyrites cluder) .. 1

Sulphur, as mined, for acid-making .. 0

(When loaded loose must be sheeted.)

Sulphur, e.o.h.p. .. 0

(When loaded loose must be sheeted.)

NEWS FROM THE SECTIONS.

BRISTOL AND SOUTH WALES.

At the meeting held on February 2 in Bristol, Dr. T. Howard Butler presiding, Prof. S. H. Reynolds, of Bristol University, read a paper on "Some Local Aspects of Industrial Geology."

Practically all the ores of the Bristol and South Wales district are due to "metasomasis," which in this case consisted in the replacement of an original sediment, generally limestone, by material introduced in percolating water acting from above downwards. Ore deposits formed in this way include:—(1) Bedded deposits in which the ore-body conforms more or less to the stratification of the beds in which it lies. Ore deposits of this type are represented by the great majority of the iron ores of South Wales and the Forest of Dean; by the ochre deposits of Winford and Wick Rocks and by the Westbury (Wilts) ironstone. (2) Fissure deposits, in which the ore may line walls of a fault or joint, or may occupy an irregular cavity. Most of the local lead and zinc deposits are to be included under this head.

The Westbury ironstone is particularly interesting, because, although the rock completely retains its original structure of an oolitic limestone, the carbonate of lime has been replaced by limonite, carbonate of iron probably forming an intermediate stage. In the ironshot oolite of Dundry the change has not gone so far, for though the oolitic grains are in the condition of limonite, the matrix is unaffected.

The British mined lead ore in the Mendips before the Roman occupation; iron mining in the Bristol district dates back to Roman times. Of other local minerals of economic value, the most important is celestine, which is the main British source of strontium compounds. Gypsum is also widely distributed in the Bristol district, and although no phosphatic deposits of economic value occur, there are several bands of phosphatic nodules of much scientific interest, including the so-called "palate bed" near the base of the carboniferous limestone, the "rhaetic bone-bed" and certain bands in the lias of the Radstock district.

With the exception of the Westbury ironstone and the phosphatic nodules, it seems probable that all the minerals referred to are of triassic age, even when occurring in pre-triassic rocks. The marked mineralisation which took place in triassic times seems to be associated with the widespread earth-movements and unconformable relations of the rocks then prevailing. Locally it is to be further associated with the terrestrial conditions tending to great erosion and the concentration of material derived from the older rocks in the salt lakes of the period.

Prof. C. M. Thompson presided at the meeting held in Cardiff on February 3, when Mr. T. M. McKenzie read a paper on "Petroleum, with special reference to Lubricating Oil."

After speaking briefly of the theories of the origin of petroleum, the lecturer described the methods of oil-boring and explained some of the many difficulties which arise and the methods of overcoming them, the breaking of bits, infiltration of salt water, and fires. He then outlined the methods of fractionation and purification of the various crude oils, noting the peculiarities of the oils from the different oilfields, including the oil recently obtained in Derbyshire. Mr. McKenzie then explained the principal requirements of lubricating oils, how they are compounded or blended, and the tests which are applied to the different types of lubricants. The flash-point, he said, was of small importance and the specific gravity of none, but much importance should be attached to oxidation and sludging tests. Some novel tests for bitumen and asphalt were described, and also the probable behaviour of oils containing these substances when used in internal combustion engines.

MANCHESTER.

A meeting was held on February 3, when Dr. E. Arden presided, and Drs. J. Callan and J. A. R. Henderson read two papers entitled, respectively, (1) "The Estimation of the Nitro-group in Aromatic Organic Compounds, Part II," and (2) "The Use of Potassium Bromate in Volumetric Organic Analysis."

(1) The authors discuss the difficulties of determining aromatic nitro-groups by the Knecht-Hibbert reduction method and show that, in agreement with their previous conclusion (*cf.* J., 1920, 86—88 τ), erroneous results are obtained when titanous chloride is used. This source of error can be eliminated by using a minimum of hydrochloric acid and an excess of sulphuric acid when carrying out the estimation with titanous chloride, or by replacing the chloride with the sulphate. It is advisable to use a reflux condenser to avoid loss due to volatilisation during boiling. Using titanous sulphate, many substances, especially mononitro-hydrocarbons and their mono- and poly-chloro-derivatives can be estimated quantitatively, provided the above-mentioned sources of error be eliminated. Para-nitroaniline is recommended for use in standardising solutions of titanous salts and

as a general standard in the analysis of dye intermediates.

(2) The authors describe the use of potassium bromate for estimating aliphatic and aromatic compounds and discuss the effect, in typical bromate titrations, of the chief factors governing bromination by nascent bromine, viz., (1) orientation of the groups forming the compound, (2) the nature of these groups, and (3) the temperature of the reaction. The application of the method to various typical aromatic substances is described.

GLASGOW.

The eighth meeting of the current session was held on February 13, Mr. J. H. Young presiding, and a paper entitled "Some Physico-Chemical Problems in Agriculture" was read by Mr. D. N. McArthur.

Mr. McArthur introduced his subject by pointing out the interest and importance of agriculture to industry in that it frequently provided an outlet for waste products, a notable instance being the iron and steel industry's by-products, some of which provided valuable fertilisers for the soil. The speaker emphasised the fact that scientific agriculture was a complex and composite study, and by no means a purely chemical one. This was illustrated by a detailed account of the methods used in studying the soil. It was pointed out that chemical analysis by itself did not enable the agriculturist to tell the farmer what should be added to his soil to render it fertile.

Mr. McArthur then dealt with the great significance of colloidal phenomena in relation to flocculation and deflocculation of clay soils, and drew attention to the importance of lime, which acts in a manner different from that of the alkalis. The behaviour of clay as an electro-negative colloid was discussed, and attention was drawn to the importance of adsorption effects in soils and to the interpretation of these in relation to acid soils. In conclusion, the speaker said that so far only the analytical side of soil study had been attacked; the synthetic side was still practically virgin ground.

MEETINGS OF OTHER SOCIETIES.

THE CHEMICAL SOCIETY.

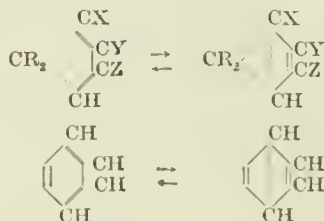
Prof. H. E. Armstrong presided at the meeting held on February 2, when five papers were presented in abstract.

The first paper, by Dr. E. J. Hartung, of the University of Melbourne, entitled "The Action of Light on Silver Bromide," dealt with the application of the micro-balance to the investigation of photochemical and allied changes in silver halides. The balance of Ramsay and Gray, which depends for its sensitiveness on the change in buoyancy of a small quartz bulb suspended in air when the pressure is varied, was used for this purpose. Methods of eliminating errors due to mercury vapour from the pump, tap grease, etc. were detailed. The thin film of silver salt employed was deposited on thin broken pieces of quartz bulbs. The author estimates that the balance is sensitive to 1 part in 10^7 and that alterations in weight of 0.001 of a milligram can be determined. Silver bromide was found to have lost 2.5 per cent. of its bromine when exposed to light in air; after being exposed *in vacuo* it lost 80 per cent., and the loss was still greater after long exposure to light in an atmosphere of nitrogen. Experiments were made on the action of light on ozone. The conclusions

arrived at indicate that the action of light causes the formation of a solid solution (presumably colloidal) of metallic silver in the halide salt and disprove the hypotheses that the action consists in the formation of a sub-halide or of an oxy-halogen.

Three important papers by Dr. C. K. Ingold, the last in conjunction with Mr. H. A. Piggott, were summarised by the former. The titles were:—"The Structure of the Benzene Nucleus. Pt. I. Intra-nuclear Tautomerism; Pt. II. Synthetic Formation of the Bridged Modification of the Nucleus; Pt. III. The Suppression of Intra-nuclear Change."

The cyclopentano compounds showing intra-annular tautomerism (J.C.S., 1920, 117, 1362; 1922, 121, 128) appear to occupy a position in the systematic classification of organic compounds intermediate between the aliphatic and the aromatic series. The possibility that the tautomerism of the alicyclic nucleus constitutes a simple prototype of the tautomerism of the aromatic nucleus:

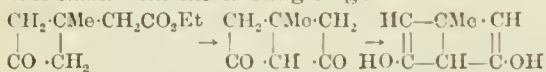


suggests the hypothesis that a phase represented by the Dewar formula for benzene forms a connecting link between the two Kekulé phases:



The principal reason for adopting this hypothesis is that from it flows a far-reaching and very direct collation of the unique and characteristic transformations of aromatic compounds, such as quinonoid conversions, substitution reactions and isomeric changes, with the well-known types of change usually regarded as appertaining only to the aliphatic and alicyclic series.

The aromatic nucleus has frequently been synthesised in its Kekulé-form, but no rational, step-by-step synthesis of the Dewar-form has previously been carried out. This has now been accomplished, however, by first preparing ethyl 3-methylecyclobutan-1-one-3-acetate, and then closing the second four-carbon ring by internal condensation of the side-chain with the existing ring:



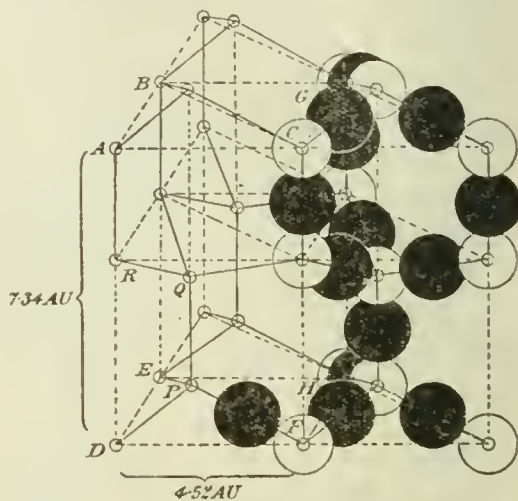
The product was identified as ordinary oreinol (3:5-dihydroxytoluene).

In the last paper, Mr. L. D. Williams discussed the results of analyses of the catalyst contained in certain German automatic gas-lighters, the efficiency of which appeared to depend upon the presence of 28 per cent. of platinum, of a chocolate colour, very finely-divided, and deposited on silicious material.

THE PHYSICAL SOCIETY.

At the annual general meeting of the Society, held on February 10, a paper on "The Crystal Structure of Ice" was read by Sir W. H. Bragg. Results obtained by A. St. John and by D. M. Dennison by the application of the X-ray method of analysis to the elucidation of the crystal structure of ice, agree in referring the structure to a hexagonal lattice composed of triangular prisms,

but differ concerning the dimensions of the lattice. In the present paper the author shows that, assuming the structure to involve the presence of twice as many hydrogen atoms grouped round each oxygen atom as there are oxygen atoms round each hydrogen atom, the resulting geometrical structure is in agreement with the measurements of Dennison, who found the respective width and height of the hexagonal lattice to be 4.52 and 7.34 Angstrom units. The low value of the density of ice suggests that ice possesses a loosely packed atomic structure. The minimum number of neighbours to each atom, in accordance with the above assumption, is afforded by a structure in which each oxygen atom is surrounded by four hydrogen atoms, and each hydrogen atom is surrounded by two atoms of oxygen, resulting in the crystalline structure shown in the figure, in which black circles represent hydrogen atoms and white circles oxygen. A B C D E F is one of the triangular prisms referred to above.



Opening the discussion, Prof. H. E. Armstrong said that he had long insisted that water existed in a variety of molecular forms. Dry steam was probably represented by the molecular formula H_2O , and to this he had given the name of hydron. Saturated steam was constituted partly of aggregates of two hydron molecules. Aggregates of four, five and six hydron molecules probably existed in water. Aggregates of six probably conferred upon ice its hexagonal crystalline structure. The potential benzene-hexagonal structure of ice was clearly brought out by the model exhibited by Prof. Bragg, and that same potential hexagonal structure was exhibited by a very large number of substances, e.g., by quinone. He anticipated that the new method of analysis would throw light upon what really happened to the molecules when water froze, and what accounted for the variation of heat capacity of the elements with change of temperature.

In a paper on "The Measurement of the Radium Content of Sealed Metal Tubes," Dr. E. A. Owen and Miss B. Taylor gave tables permitting corrections to be applied to the ascertained radium content of cylindrical tubes, on account of absorption of radiation by the walls of the tube.

Prof. Kerr Grant submitted a paper on "A Method of Exciting Vibrations in Plates, Membranes, etc., based on the Bernoulli Principle." Vibrations in a plate or diaphragm are maintained by the aid of a stream of fluid impinging upon the plate or diaphragm, which is supported at its bound-

dary. The device has found application in the construction of sirens operated by compressed air at 80 lb. per sq. in., the resulting sound being audible at a distance of one mile.

INSTITUTION OF RUBBER INDUSTRY.

On February 6, Mr. J. L. Rosenbaum read a paper on "Rubber Mixtures and Accelerators" at the meeting held in Manchester, Mr. J. H. C. Brooking presiding.

The history of the subject was briefly reviewed, and the mechanism of the action of accelerators discussed. After mentioning the more important organic accelerators available to-day, Mr. Rosenbaum described a group of accelerators which he had discovered in the laboratories of the Hooley Hill Rubber and Chemical Co. Investigation of the colour bases of the basic dyes showed that many of them, *e.g.*, methyl violet base, possessed very marked accelerating efficiency, and that the colour produced in the mixing persisted during vulcanisation even at high temperatures and in the presence of excess of sulphur. Of other colour bases some (*e.g.*, auramine base) were very good accelerators, but lost their colour on vulcanisation, whereas others retained their colour, but were poor accelerators. It was ultimately discovered that all the colour bases of the basic organic dyestuffs could be used as accelerators, and this use was patented (E.P. 141,412 of 1919; J., 1920, 460 A). Mr. Rosenbaum pointed out that, when using an accelerator, the best commercial results could be obtained by diminishing the quantity of sulphur in the mixing. Apart from the saving in time, steam, and labour accruing from the use of accelerators, they also prevented "sulphuring-up" or "blooming," and improved both the physical qualities of the rubber and the ageing properties. They could also be used in making rubber sheaths for electric cables when no free sulphur could be permitted in the mixing. Their toxic properties had been rather exaggerated.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

At a meeting held on February 9, Mr. H. M. Langton read a paper entitled "Studies in Saponification," which embodied the results of experiments carried out on a large scale under standard conditions.

After a brief statement of the history of the scientific study of the subject and the theoretical considerations involved, the author pointed out that though several authorities made definite statements about the relative merits of lime, magnesia, and zinc scrap as splitting agents, and of the best pressures at which to operate and the comparative ease or difficulty with which specific oils were satisfactorily decomposed, none of these authorities had given actual results of experiments carried out under conditions which made comparison possible. In his tests the amount of catalyst was fixed at 2.5 per cent. and the pressure at 8 atm., whilst the results were the averages of a series of "runs" on each oil, the total amount varying from 200 to 300 tons in each case. The differences between the results with different oils were not great, nor did lime or magnesia show great differences, but they were consistent differences and worthy of attention. In every case there appeared to be a distinct pause in the splitting process between about the 4th to the 6th hour. Perhaps this accounted for the fact that some workers considered it good practice to stop the process and blow off the glycerin and then continue after adding more water and catalyst. In his opinion, however, that was not worth the time and trouble involved.

Mr. Langton then showed curves indicating the progress of splitting during each hour. A typical

curve was that of tallow—1st hour 60%, 2nd hour 70%, 10th hour 98.1% split. In this case magnesia gave slightly better results than lime, which contradicted Lewkowitsch's statement, whereas using Niger palm oil magnesia gave slightly better results than lime. Other results were as follows:—(1) Linseed oil: 92% split. Lime and magnesia gave equally good results. (2) Palm-kernel oil: lime 94% split, magnesia 94.5%. (3) Whale oil No. 1: lime 93.9%, magnesia 95.7%.

From the results of his experiments, which involved the use of some 3000 tons of oil, the author concluded that the order of completeness of splitting was: tallow, whale, palm-kernel, palm, and linseed oil; and that the choice between magnesia and lime depended upon the oil in use. He found no appreciable difference between English and Australian tallows, or between the different grades of whale oil.

THE FARADAY SOCIETY.

At a meeting held on February 13 at Burlington House, W., Prof. J. R. Partington read a paper on "The Energy of Gaseous Molecules," in which he discussed the agreement between the theoretical values of atomic or molecular heats and the experimental data.

In the case of the five inert gases, mercury and iodine vapour, the nuclear structure of the atom has no appreciable influence on the molecular heat, which, with the possible exception of helium, is independent of temperature, and agrees with the figure deduced from the dynamical theory for molecules having three degrees of freedom and behaving as smooth elastic spheres. The behaviour of a molecule during collision is determined by the configuration of the outer shell of electrons, and, by analogy with the excitation of emission spectra by electronic bombardment, the exchange of energy in ordinary collisions may take place by quanta determined by the collision frequency of the gaseous molecule. The theory of equipartition of energy among the several degrees of freedom of the molecule has been made to cover the experimental results without recourse to the quantum theory, on the supposition that a molecule may have a different number of degrees of freedom at different times. It becomes necessary, however, to ascribe three degrees of freedom to the diatomic hydrogen molecule, a result which is difficult to interpret, since it means that translational motion only takes place.

The diatomic gases fall into three groups:—(a) Hydrogen, having a molecular heat which is appreciably lower than the equipartition value for a molecule having five degrees of freedom, and which diminishes rapidly with temperature. (b) Oxygen, nitrogen, carbon monoxide, nitric oxide and the halogen hydrides, for which the molecular heat at ordinary temperatures agrees with the equipartition value and varies but slowly with temperature. (c) The free halogens, having molecular heats corresponding to six degrees of freedom on the equipartition theory at ordinary temperatures, but independent of temperature. The experimental data are insufficient to be applied to polyatomic molecules, but it has been found that the molecular diameter, refractive index, dielectric constant and the constants in Van der Waal's equation increase with the "residual energy," obtained by deducting the equipartition value for a molecule with six degrees of freedom from the observed value of the molecular heats of CH_4 , CO_2 , N_2O and C_2H_4 .

Dr. Partington also discussed the consequences of assuming that energy exchanges during collision take place by quanta determined by the collision frequency. None of the existing formulæ give

correct values for the variations of the molecular heat of hydrogen with temperature. Bohr's theory of atomic structure is the most accurate in this respect, though even it gives results far from precise.

The second paper, by Ulick R. Evans, was entitled "Passivity and Over-potential." In a general survey of the problem of corrosion and the part played by "protective" films in preventing corrosion of metals, it was suggested that the formation of such a film is analogous to the separation of ores by flotation, and that the product of corrosion clings to the metallic surface or enters the body of the liquid according to the relative values of the interfacial surface energies. On this view "anodic passification" is due to a layer of adsorbed oxygen atoms on the metallic surface, which reduces the discontinuity at the interface and therefore the interfacial energy. The hypothesis explains the failure of the metal to enter into solution and the diminished photo-electric effect shown by iron in the passive state.

After considering the question of the existence of chemical compounds on the surfaces of metals in the passive state and Friend's colloidal theory of corrosion, Mr. Evans showed how the theory of corrosion provided a convenient interpretation of over-potential.

Prof. A. W. Porter communicated a "Note on the Vapour Pressure of Ternary Mixtures." In the case of binary mixtures the vapour pressure may be derived from a potential function by differentiation with respect to the numbers of molecules. This potential function, being symmetrical in the molar fractions, may be extended to cover the case of a ternary mixture and the vapour pressures of the constituents derived by partial differentiation as before. The results of this were shown to be in agreement with the scanty experimental data available.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

A meeting of this Institution was held on February 14. Prof. J. S. S. Brame presided and a paper was read by Mr. J. E. Hackford on "The Significance of the Interpretation of the Chemical Analyses of Seepages."

Mr. Hackford presented a selection of analyses of oils taken from a small area in Mexico and pointed out how greatly the local geological conditions (the thickness of a bed of sulphurous dolomite) modified the sulphur and asphalt content of the oil. The presence of faults also markedly increased the oxygen content of the asphaltenes.

Correlation of the chemical nature of the oil-forming material with that of the resultant oil led him to conclude that algae may yield sulphurous oils free from nitrogen, but oils of marine-animal origin will be much richer in nitrogen. Further, since algae contain no cellulose, aromatic compounds will be absent. A cellulosic deposit, owing to its spongy nature, will retain oily products of the decomposition sufficiently long for the asphaltenes in this oil to become converted into kerotenes and ultimately into coal.

The vague term "bitumen" has long been employed for solid petroleum derivatives of widely varying nature, and it was claimed that a systematic classification could be achieved by a subdivision into the four distinctive classes, oxy- and thio-asphaltites and oxy- and thio-kerites.

By classifying a bituminous seepage under one of these heads and determining the chemical characteristics of any oily matter which might be extracted from it by solvents, it was possible to predict with considerable accuracy the nature of the oil from which the seepage was derived.

Similar conclusions, though less reliable, could be drawn from the nature of gases emitted by accumulations of oil.

The discussion was opened by Prof. Brame and continued by Sir Thomas Holland, Dr. Ormandy, and others, the importance of further chemical investigation of solid, liquid and gaseous petroleum seepages being emphasised. Mr. Hackford's scheme of classification of bitumens was favourably received.

THE INSTITUTE OF CHEMISTRY.

The interesting subject of "What the Manufacturer Expects of His Chemists" was discussed at a crowded meeting of the London Section on February 15. Mr. E. Richards Bolton, chairman of the Section, presided, and the discussion was opened by Mr. G. J. Lemmens, managing director of Messrs. Lipton, Ltd., who gave an address to young chemists which was full of sagacious thought and punctuated with many apt illustrations and anecdotes.

Among the chief qualities which the manufacturer expects his chemists to possess is initiative. The average chemist is too apt to tread the beaten track; the manufacturer often does not know what he wants and would like the chemist to tell him. Allied to this quality is that of general broadness of outlook, which is often lacking in the young chemist who has been trained in an analyst's laboratory, and who, in consequence, finds himself at sea when confronted with questions of cost and yield, questions which should be brought to him by the manufacturer. Common sense and tact, which everyone sees in himself and misses in others, are of paramount importance, particularly in technical control, and in their absence there is continuous conflict between the trained technical man and the rule-of-thumb worker, with the victory often to the latter. Grasp of essentials is another important attribute, especially with reference to the wants of the ultimate consumer. Scientific humility is also necessary, and few things irritate the manufacturer more than the vaunting of common text-book knowledge as a means of solving intricate technical problems. The quality of persisting in effort, even in drudgery work, refusal to accept standard practice and the cultivation of the "activating" scepticism (Goethe's *thätige Skepsis*) are likewise factors contributory to success. Among other desiderata are the possession of some legal knowledge, acquaintance with the latest technical literature, and willingness to allow the other man to have the credit, even if it belongs to oneself.

The discussion was a long one and covered many important points, but suffered somewhat from the absence of manufacturers. Mr. R. L. Collett, hon. sec., raised the question of the relations between the technical staff and the rule-of-thumb men. He referred to the difficulty the chemist experiences in finding out from the foreman what has gone wrong in a process (the foreman's reply is invariably a recital of his instructions and not of his actions), and to the further difficulty of conveying information to the directors without insinuating inefficiency on the part of the worker. A subsequent speaker gave the advice that the chemist should make himself known to the foreman as a detective—of faults in the process—and not as a spy—on human conduct; and another suggested that the institution of works' committees, comprised of representatives of both the scientific and the rule-of-thumb workers, was a most helpful preventive and corrective of mutual misunderstanding. Mr. Collett also introduced discussion of the question whether the technical man should have powers beyond those of an adviser. Mr. Lemmens, in his reply, expressed the opinion that the chemist should act in an advisory capacity only; he should have no ad-

ministrative functions, and executive powers should be left to the titular managers of departments.

Except for an indication in the chairman's concluding remarks, there was a noticeable absence of any reference to the need of clear, logical and terse expression in the writing of reports and in other forms of intercommunication. Manufacturers, as a class, and technical men do not speak the same language, and this circumstance is a fruitful source of misunderstanding. If the chemist may reasonably expect that his employer shall have an elementary knowledge of scientific principles, the manufacturer can at least demand that his scientific adviser shall be able to express his thoughts—as well as his wants and feelings—in clear, precise and concise language unadulterated with technical jargon; to adopt a phrase of Sir A. Quiller-Couch, he must not only be able to “call a spade a spade,” but he must double spades and re-double.

NEWS AND NOTES.

BRITISH INDIA.

Indigo Research.—In a letter to *The Times* of February 20, Prof. H. E. Armstrong states that he has received the following telegram from the Indigo Research Chemist in India (Mr. W. A. Davis):—“Coming home—indigo discontinued.” Prof. Armstrong enumerates some of the valuable results that have been obtained from the research, points out the urgent necessity for continuing the work, and concludes by stating that its interruption will be economic suicide, pure and simple.

The Paper-making Industry.—The Indian paper-making industry was initiated by missionaries, who established a plant in the Danish settlement at Tranquebar in 1716, and subsequently at Serampore in 1811. The real beginning of the industry, however, dates from 1867 when the famous Bally Paper Mills were established. In the early days, the material used was exclusively cotton rags, of which supplies necessarily became limited. Later, the possibilities afforded by the wealth of native vegetable fibres—first *moonj* grass and more recently *sabri*—led to important developments. By the time, however, that the Indian industry had become established, mechanical wood pulp came into use, and the effect of the ravaging of the Scandinavian and American forests was to deprive the Indian industry of all but an infinitesimal share of the available markets.

Grass paper is unable to compete in price with mechanical-pulp paper, and the market for better grades is not only very limited but it demands a great deal of specialisation. The industry is therefore forced to struggle very hard for its existence, and in attempting to hold their ground, Indian mills are driven to undertake the manufacture of many different grades and specialities. The outlook was poor before the war; recently it has been affected by dumping, in the first instance by Germany, Austria and Scandinavia, and latterly, as a result of the slump in trade, by Great Britain, whose mills are offering paper on the Indian market at prices below the cost of production.

The preservation of the Indian paper-industry is important not only because it employs a large amount of labour but also because it offers a market for heavy chemicals. Had it not been for the native industry there would have been a paper famine during the war. The industry needs Government aid, which could take the form of fiscal protection, development of forest areas and extraction of grass, and improvement of railway transport facilities and favourable railway rates. The economic handicap

against the Indian industry is, however, enormous, and the relative smallness of the mills is a serious factor; the combined output of the four largest is only 96 tons per day.—(*J. Ind. Indust.*, Nov., 1921.)

SOUTH AFRICA.

Manufacture of “Natalite.”—The *South African Sugar Journal* states that a plant of new design has been erected for the manufacture of “natalite” in South Africa, by a Glasgow firm. It is stated that in numerous operating tests the plant has given great satisfaction, as it yields a practically pure, neutral spirit of 95-97 per cent. strength continuously in one operation.—(*S. Afr. J., Ind.*, Jan., 1922.)

AUSTRALIA.

Experiments in Paper-making.—The West Australian Forests Products Laboratory and the Commonwealth Institute of Science and Industry have been authorised to conduct experiments on a semi-commercial scale with a view to ascertaining if it be possible to produce paper pulp from Australian timber. The Federal Government is spending £2490 a year in salaries, and providing equipment for the investigations. In addition, the Institute is spending a special appropriation of £2000 in carrying out experiments, the West Australian Government has contributed £1900, certain newspaper companies £600, and other States £1300 between them. The West Australian Government has offered £5000 conditionally upon the Commonwealth Government finding a similar amount for the purpose of building a laboratory in West Australia.—(*Ind. Austral.*, Dec. 22, 1921.)

UNITED STATES.

Fuel-Efficiency in High-Compression Motors.—The Committee on the Uses of Selenium and Tellurium appointed by the Engineering Division of the National Research Council reports that the addition of a tellurium compound to gasoline for use in high-compression motors of automobiles prevents the “knocking” that occurs when ascending an incline with the throttle open. The discovery, which is due to Messrs T. Midgeley and T. A. Boyd, chemists to the General Motors Corporation, allows a higher compression to be used and increases the mileage by 100 per cent. So far only selenium oxychloride and diethyl telluride have been experimented with. The Committee is now investigating possible new sources of supply of tellurium, for it is estimated that even the addition of 0.01 per cent. to the gasoline annually consumed in the United States (30 billion lb.) would require 1500 tons, whereas the present production at copper and lead refineries does not exceed 56 tons.

Alcohol as Motor Fuel.—Owing to the diminishing supply of gasoline, Mr. Harrison E. Howe estimates that the price will rise to 40-50 cents per gallon by 1925, and he looks to alcohol to make up the prospective deficiency. Unfortunately, however, the plant for producing alcohol has been reduced by about 50 per cent. since 1918, when Prohibition came into force, and the production in 1919 was less than 1 per cent. of that of gasoline. The use of maize as raw material is regarded as the most promising source of future supplies of alcohol, which will have to be blended with benzene, gasoline, or kerosene. Such a blended fuel is to be produced by the U.S. Industrial Alcohol Co., which is erecting a large plant for the purpose in Baltimore.

New Sulphur Deposit in Texas.—It is reported that the Texas Co. has proved the existence of a deposit of sulphur at Hoskins Mound, Texas, underlying an area of nearly 28,000 acres and said to be the largest known sulphur deposit in the world. It is proposed to mine the sulphur by the Frasch process

and to erect a plant costing about \$5,000,00, which will be ready to start by the end of the year.—(*Oil, Paint and Drug Rep.*, Jan. 23, 1922.)

Abrasive Materials in 1919 and 1920.—Natural abrasives were produced in 26 States in 1919 and 1920, the chief centres of production being:—Virginia, millstones; Michigan, Ohio, and W. Virginia, grindstones and pulpstones; Illinois, tripoli; California, Connecticut, Idaho, Maryland, Nevada, and New York, diatomaceous earth. Sales during 1918, 1919 and 1920 were valued at \$2,864,332, \$2,887,902, and \$4,299,812, respectively; the output of grindstones and pulpstones decreased in 1919, but recovered in 1920, whereas the production of other abrasives, especially diatomaceous earth and pumice, improved. Values of sales, imports, exports, and apparent consumption in the United States in 1919 and 1920 were as follows:—

	1919.	1920.
	\$	\$
Natural abrasives (sales) ..	2,887,902	4,299,812
Artificial abrasives (sales) ..	5,019,779	6,269,084
Imports	2,237,077	4,425,409
Total	10,144,758	14,994,305
Exports	6,138,366	7,025,621
Apparent consumption ..	4,006,392	7,968,684

The value of sales of artificial abrasives in the above table does not include the output of one large company. No progress is recorded in the manufacture of artificial abrasives. (*Cf. J.*, 1921, 106 R.)—(*U.S. Geol. Surv.*, Sept. 16, Oct. 28, 1921.)

CANADA.

The Pulp and Paper Industry.—The recent cut in the price of newsprint paper to \$70 per ton is bringing in many orders, and it is expected that the mills will shortly be working at full capacity.

The newsprint-mill of the International Paper Co., at Three Rivers, Quebec, was scheduled to begin operations early in February. Starting with two machines, the initial output will be 100 tons a day, which it is hoped to increase to 200 tons, or about 60,000 tons a year.

The Government of Alberta is investigating the spruce and poplar in the northern part of that province, and in the foothills, from the standpoint of their suitability for wood-pulp manufacture.

Provincial Paper Mills, Ltd., at Port Arthur, Ont., is to erect immediately a paper-mill in connexion with its pulp-mill which will cost about \$1,500,000. Much of the machinery will be manufactured in Port Arthur.

The capital stock of the St. George Pulp and Paper Company (St. George, N.B.) has been increased to \$500,000.

The Sissiboo Pulp Company, at Weymouth, Nova Scotia, which is owned mainly by British paper interests, is reported to be considering the erection of a paper-mill in connexion with its pulp-mill.

The Starch and Glucose Industry in 1918.—The report presented by the Dominion Bureau of Statistics upon the starch and glucose industry in 1918 states that there were twelve establishments, having a total asset value of \$3,784,664, which includes not only the land, buildings, equipment, but also the raw materials, semi-prepared and finished products, fuel, miscellaneous supplies, etc., that were on hand at the close of the year. The salaried employees numbered 71, receiving \$98,595, and the average number of wage earners was 633, receiving \$541,550.

The sum of \$339,763 was charged to manufacture under the heading of miscellaneous expenses, and does not include power, fuel, etc. The cost of the raw materials employed in the industries was \$4,992,705, divided as follows:—Corn (139,974,408 lb.), \$3,858,312; potatoes (9,923,279 lb.), \$106,061; corn starch (503,950 lb.), \$32,495; sugar and syrup (1,657,082 lb.), \$133,399; containers,

\$750,560; chemicals, \$44,763 (chiefly hydrochloric acid); other materials, \$87,112. The products, whose total value was \$7,620,864, were as follows:—

	Long tons.	\$
Corn starch	8,501	1,445,324
Laundry	2,152	391,456
Potato	918	177,353
Chinese	564	122,284
Glucose syrups	28,930	4,191,098
Grape sugar	307	37,392
Stock feed	12,955	796,349
Dextrin	292	54,949
Corn oil	242,451 galls.	404,650

Proposed Wood-Pulp Industry in Alberta.—A thorough investigation into the possibilities of establishing a wood-pulp industry in Alberta is to be made under the direction of the Advisory Council for Scientific Research. At a recent meeting of the Council it was decided to proceed with the work as soon as the necessary arrangements could be made. Should these inquiries prove as successful as expected, large areas of spruce and poplar timber in the northern part of the country and in the neighbourhood of the western foothills will be turned to profitable account. The opinions of several experts have already been secured, and their belief in general is that the possibilities are great. Experiments to be made at the University laboratories in Edmonton will prove whether this belief is well-founded or not.—(*Canadian Lumberman*, Jan. 15, 1922.)

FRANCE.

Increase in Patent Fees.—From January 1 the fees payable annually for French patent rights have been increased to 125 francs per annum for the first five years, 200 fr. per annum for the second five years, and 300 fr. per annum for the third five years. The increases are only payable if the fees are due on and after January 1, 1922, and do not apply when the fees for the whole life of the patent were paid before that date. No alteration has been made in the scale of fees payable for printing specifications that are more than a certain length or include numerous designs. The fee for additions to patents has been raised from 20 fr. to 100 fr. and the application for any patent or addition will be cancelled unless a tax of 10 fr. is paid by the applicant within three months after the date of an official request for payment.—(*Chim. et Ind.*, Jan., 1922.)

Industrial Notes.—Chemical Industry.—With the approach of spring the demand for fertilisers is improving and large quantities of potash have been shipped to the United States. Owing to the shortage of ammonium sulphate, probably about one-half of the French stocks of nitrate of soda has been sold; consignments of the latter have, however, arrived at Dunkirk and Bordeaux. There is a brisk demand for superphosphates. Imports of mineral phosphate during the first nine months of 1921 amounted to 553,882 metric tons, of which 436,000 t. came from Tunis, 73,000 t. from Algeria, and about 40,000 t. from the United States.

According to General Ipatieff, the chemist who was in charge of the Department of Explosives Supply of Russia before the war, dyes, pharmaceutical products and laboratory apparatus are wanted in that country, and the chemical factories need plant, machinery and apparatus.

Metallurgy.—Negotiations are in progress for the conclusion of an international agreement for the sale of metallurgical products. The consummation of such an agreement would imply preparatory reorganisation in the individual countries, e.g., an arrangement between metallurgical interests in France, Belgium and Luxembourg. In France the question of resuscitating the "Comptoir Sidérurgique" is under discussion, but the diffi-

culty of allocating production has so far prevented an agreement being reached. The reconstruction of the "Comptoir des Aciéries Belges" is proving very difficult, the Belgian metallurgical firms being less united than the French, and much less than the British. This lack of individual agreement is all that stands in the way of a grouping of the Belgian, French and Luxembourg metallurgical companies, the main outlines of which have already been planned. A group representing French, Belgian, and British interests would have as its chief object the standardisation of export prices, organisation of the markets, etc. As soon as there is complete agreement between the Allied interests, negotiations will probably be opened with the German iron and steel industry.

Owing to the uncertain political outlook the market is now very depressed and buyers are only purchasing for immediate needs.

Fuel.—The shortage of metallurgical coke due to the German railway strike has again drawn attention to the danger of the French metallurgical industry becoming dependent on Germany. It is therefore urged that coke production must be speeded up in the Saar and Nord districts. The total French output of coal in 1921 was 23,210,887 m. tons (5,365,262 t. from the devastated regions) and of lignite 735,608 t. Imports from Germany during the year were 6,137,000 t. of coal, 3,082,000 t. of coke, and 471,000 t. of lignite—figures very remote from those stipulated in the Peace Treaty.

Petroleum.—The "Société Générale des Huiles du Pétrole" has come to an agreement with the Anglo-Persian Oil Co. The object of the French company, 45 per cent. of the capital of which has been subscribed by the English company, is to import, treat and sell petroleum and its products in France. The Pechelbrunn Petroleum Co., which owns 11,880 acres in the neighbourhood of Strasbourg, is issuing 60,000 new 6½ per cent. bonds of 500 francs each at 495 francs. Two wells and 600 pumps are now in full activity and three new wells will soon be started.

GENERAL.

Sampling and Analysis of Coal.—The Fuel Research Board of the Department of Scientific and Industrial Research has appointed the following to serve as members of a committee to advise upon the sampling and analysis of coal:—Prof. T. Gray (chairman), Prof. J. W. Cobb, Dr. J. T. Dunn, Dr. J. S. Flett, Mr. G. Nevill Huntly, Mr. S. Roy Illingworth, Mr. J. G. King, Dr. C. H. Lander, Dr. R. Lessing, Mr. C. A. Seyler, Mr. F. S. Sinnatt, and Prof. R. V. Wheeler. It is intended that the methods recommended by the committee shall be adopted in the physical and chemical survey of the national coal resources to be conducted under the Board (*cf.* J., 1921, 34 R). Communications to the committee should be addressed to the secretary, Miss N. Renouf, 16 and 18, Old Queen Street, S.W. 1.

Salt Deposits in Czechoslovakia.—There are two salt mines in Czechoslovakia: one at Solnohrad, near Presov (Slovakia), and the other at Marmarozska Solotvina (Rusina). The equipment at Solnohrad is very primitive; the mine is flooded with water and the brine evaporated by wood fuel. Although these deposits are probably very extensive, the output is not more than 2 truckloads a day, but it is proposed to erect modern plant at a cost of 14 million kronen (about £62,222 at present rates), and to increase the output by 50 per cent. The Rusinian deposits are estimated to contain 60 million metric tons of salt which, on the basis of an annual consumption of 300,000 t., would last 200 years; the actual daily output is 30 truckloads. If these two mines were fully developed, their output would amply meet the domestic demand of 80 truckloads a day.—(*U.S. Com. Rep.*, Dec. 26, 1921.)

"Fluorspar (1913—1919)" (Imp. Min. Res. Bureau, pp. 18, price 9d.).—In this publication there are notes on the sources, production, and characteristics of the fluorspar produced in the United Kingdom, South Africa, Canada, Australia, the United States, and Germany, and a useful bibliography of the technical literature of the subject is appended. Both as a producer and consumer the United States stands first. Production in and exports from the United Kingdom have been as follows:—

Year.	Production.		Value.	Export Value.
	Quantity.	Value.		
	Long tons.	£	£	£
1913	53,663	14,955	11,337	
1914	33,816	11,005	10,406	
1915	33,123	11,484	14,987	
1916	54,731	18,697	20,285	
1917	64,874	30,462	25,252	
1918	53,498	41,310	26,311	
1919	36,860	36,252	22,055	

Most of the fluorspar exported from the United Kingdom has been shipped to the United States, but the amount has been far less than before the war, probably because the mineral is now used at home, principally for producing basic steel.

The world's annual output of fluorspar, which is estimated at about 300,000 tons, appears to be consumed roughly as follows:—Metallurgical operations, 80—85%; manufacture of glass, enamelled sanitary ware, 10—15%; chemical industry (hydrofluoric acid, etc.), 5%; other uses, including emery, carbon electrodes and optical lenses, 0·5%.

PERSONALIA.

Dr. A. Russell has been elected president of the Physical Society of London.

December 27, 1922, is the date of the centenary of the birth of Louis Pasteur.

Dr. Lester A. Pratt has been appointed Head of the Research Department of the Merrimac Chemical Company, U.S.A.

Dr. W. B. Tuck, university professor of chemistry in the Middlesex Medical School, has been appointed a Fellow of University College, London.

Dr. A. Hutchinson, Prof. F. L. Pyman and Dr. N. V. Sidgwick are among the candidates recommended for election to the Fellowship of the Royal Society.

Mr. A. B. Houghton, of New York, vice-president of the Ephraim Creek Coal and Coke Co., and a well-known glass manufacturer, has been appointed U.S. Ambassador to Germany.

Prof. Edoardo Rap, professor of chemistry in the Royal Technical Institute in Salerno, has been appointed principal of the Royal Technical Institute in Palermo.

Prof. T. E. Mather is to retire at the end of the current session from the chair of electrical engineering in the City and Guilds of London Institute, South Kensington, which he has occupied for the last 37 years.

The chair of mining at Sheffield University, vacant by the death of Prof. F. E. Armstrong, has been filled by the appointment of Mr. Douglas Hay, B.Sc.(London), A.M.Inst.C.E. In the same university, Mr. H. W. Southgate has been appointed lecturer in pharmacology.

Dr. Alfred Stock, extraordinary professor of inorganic chemistry in the University of Berlin, has been appointed ordinary professor in the same university; Dr. J. Jedlicka has been appointed professor of the chemical technology of wood in the Czech Technical "Hochschule" in Prague; Prof. O. Hönigschmid, of the University of Munich, has been called to the chair of chemistry in the Technical "Hochschule," Aachen, as successor to

Prof. Classen; and the chair of analytical chemistry in the University of Briinn (Czechoslovakia) has been filled by the appointment of Prof. J. V. Dubsky.

We regret to record the death, at the age of 51 years, of Dr. Charles Baskerville, professor of chemistry in the College of the City of New York, and a member of this Society since 1895.

The deaths are announced of Dr. H. P. Armsby, director of the Pennsylvania Institute of Animal Nutrition, and of Dr. W. Frear, who was long connected officially with the Pennsylvania Agricultural Experimental Station and the U.S. Department of Agriculture.

Sir Edward Tootal Broadhurst, Bart., who died on February 2, at the age of 63 years, will be remembered as one who did much to develop the textile industries, and particularly the cotton industry, in their technical, scientific and educational aspects.

The deaths are announced from Germany of Dr. Th. Liebisch, professor *emeritus* of mineralogy and petrography in the University of Bonn, aged 70 years; of Dr. E. Ebler, professor of inorganic-analytical chemistry in the University of Frankfurt; and of Hans Illig, engineer, a former director and one of the founders of the Elektro-Osmose A.-G.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Carbon Monoxide in Coal Gas.

The House has approved of the draft of a special Order, proposed to be made by the Board of Trade under the Gas Regulation Act, 1920, to limit the proportion of carbon monoxide which may be supplied in gas used for domestic purposes.—(Feb. 10.)

Referring to this Order, Mr. Baldwin said that its effect would be to prohibit the supply of gas containing carbon monoxide unless it had a distinctive, pungent smell. There was no statutory limit to the carbon-monoxide content of gas, but from information obtained by the Board of Trade the content was rarely above, and usually considerably below, 20 per cent.—(Feb. 13.)

Imports from Germany.

Mr. Baldwin, in reply to Mr. Doyle, gave the tonnage and value of certain goods imported from Germany in 1921, as follows:—

	Tons.	£
Iron and steel, and manufactures of	103,795 ..	2,303,160
Pig iron, ferro-alloys	69,370 ..	296,909
Dyes and dyestuffs obtained from coal tar	2,123 ..	797,576
Chemicals (other than drugs and dyestuffs)	78,668 ..	1,079,982
China, pottery, earthenware ..	7,773 ..	335,403

—(Feb. 13.)

Merchandise Marks.

Mr. Baldwin informed Mr. Terrell that a Bill based on the recommendations of the Merchandise Marks Committee would be introduced during the current session.—(Feb. 13.)

Indian Opium Trade.

Answering Mr. Perkins, Mr. Montagu said that, in 1920, the area under the opium poppy in British India was 143,750 acres and the production of raw opium 1,209,600 lb.; exports of raw opium from British India during the year had been as follows (pounds):—Straits Settlements 432,600; Dutch E. Indies 406,000; Siam 238,000; British North Borneo 24,640; Ceylon 8400; Japan 126,000; Mauritius 4900; French Indo-China 133,000; Hongkong (including Macao) 99,540.—(Feb. 14.)

Excise Duty on Home-Grown Sugar.

Answering Mr. C. White, Sir R. Horne said that the revenue derived from the excise duty on home-grown sugar during the current financial year up to January 31 was about £88,000. The rate of duty per ton was five-sixths of £23 6s. 8d. on sugar polarising at over 98° and proportionate rates on sugar of lower polarisation.—(Feb. 16.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Scheduled Articles.—It is not possible to state the number of articles included under Part I. which have never been manufactured in this country. The industries to which the Act relates and the range of their production of goods not hitherto made in this country are extending in accordance with the object of the Act.—(Feb. 9.)

French Import Duties.—The changes made in the French customs tariff neither began with nor were influenced by the passage of the Act.—(Feb. 9.)

Effect on Prices.—Such statistics as are available show that the movement of prices of many commodities affected by the Act is downwards and that increases are infrequent.—(Feb. 13.)

Scientific Apparatus.—No complaints that scientific apparatus for research work is difficult to obtain have been received by the Board of Trade, but complaints received by the Department of Scientific and Industrial Research are being investigated.—(Feb. 13.)

Complaints.—The Board of Trade has received under Section 1., sub-section 5, 380, complaints respecting the inclusion of commodities in the lists of dutiable articles, of which 360 are covered by complaints from two traders' associations; and 160 in respect of exclusion, of which 150 emanate from an association of manufacturers. It is not certain that all these complaints will be proceeded with, and so far formal statements of the precise grounds have been furnished for 16 commodities only; of these the Referee has heard three, and when a few representative cases have been decided it may be practicable to determine the other cases rapidly.—(Feb. 13.)

The Santonin Decision.—The Referee has stated that he would not regard the principles adopted by him in his judgment in the Santonin Case as binding in respect of other cases; further cases will have to be decided before the Board of Trade can scrutinise the lists in the light of any general principle or principles enunciated by him. The costs, including the fees of the Referee, incurred by the Board of Trade to date amount to less than £700.—(Feb. 13.)

Gas Mantles.—The Referee has not yet made his award; consequently the Board of Trade has not taken action.—(Feb. 13.)

Compound Articles.—The Finance Bill is to include a provision enabling the Treasury to exempt from duty any compound article liable to duty, if it is satisfied: that the compound article would not be dutiable if it did not contain as an ingredient or part an article liable to duty; that in view of the nature of the dutiable ingredient, and its small value in proportion to the value of the compound article, it is inexpedient to charge the duty.—(Feb. 13.)

Revenue.—The total amount of duty collected during the four months ended January 31, 1922, was £88,138, levied as follows:—Goods from France £12,524, from the United States £12,017, from Belgium £1466, from Italy £3423, from Japan £617.—(Feb. 14.)

REPORTS.

REPORT OF THE MEDICAL RESEARCH COUNCIL FOR THE YEAR 1920—1921. Pp. 114. H.M. Stationery Office. 1921. Price 3s. 6d. net.

This report furnishes a good illustration of the manifold applications of chemical methods to the investigation of the problems of medicine. Consisting, as it does, of a masterly compression of the work of some 300 investigators, it is only possible in this place to indicate some of the results considered. The most prominent place is taken by therapeutic problems. Efforts have been directed to defining and elaborating physiological methods of standardising such drugs as pituitary extract, digitalis, and salvarsan, as well as of various toxins and antitoxins. With regard to salvarsan, the methods were directed to the determination, not only of the toxicity, but also of the curative power, and promising results have been obtained. An impurity in commercial salvarsan has been identified (H. King. J. Chem. Soc., 1920, 119, 1107, 1415). Researches on the therapeutic properties of the cinchona alkaloids have also been carried out. Study of the acridine and phenazine compounds by Prof. J. B. Cohen has thrown several interesting side-lights; for instance, it appears that the potency of the antiseptic action depends on the presence of alkyl groups attached to the nitrogen of the acridine or phenazine molecule. The therapeutic value of oxygen has been investigated by Prof. L. Hill, who has also shown, with Dr. H. H. Dale, that mixtures of nitrous oxide and oxygen may be used for the maintenance of anaesthesia for prolonged periods without inducing oxygen-lack, provided that the operation be conducted under slightly increased atmospheric pressure.

In the province of industrial chemistry the most interesting investigations have been those concerned with occupational diseases: dust inhalation, and particularly the inhalation of silicious dust (leading to silicosis) have been investigated with important and far-reaching results. Ankylostomiasis in Cornish mines has formed the subject of other researches of a purely technical nature. In organic chemistry, mention must be made of the work of Dr. H. W. Dudley, who has prepared glycylcholine (J.C.S., 1921, 119, 1256) as the first of a new series of such cholino derivatives, which may prove of physiological interest; the same investigator has also studied, with Dr. Dale, the physiological effects of *n*-methylhistamine, and of tetrahydropyrido-3,4-iminazole. (J. Pharm. Exp. Ther., 1921, 18, 103.) Dr. H. King has also published work on ortho-paraisomerism in the preparation of diaminophenylmethane (J.C.S., 1920, 117, 988), and, with collaborators, work on addition compounds of glycino (Biochem. J., 1920, 14, 574) and antipyrilaminodiacetic acid (J.C.S., 1921, 119, 292) with various neutral salts.

As examples of investigations in biochemistry may be quoted the researches on the isolation of the active principles of the pituitary, on anaphylaxis, the fate of various sterols in the body, acidosis, on vitamins and rickets, on the biochemistry of pregnancy, and on the properties of haemoglobin. All of these are too specialised for profitable comment here, and represent the results of much patient work, which is still in progress. The task of tracing the active principle of the pituitary body has occupied Dr. Dudley for several years. At each stage of the process physiological methods are employed for identifying the active constituent. This laborious work has already shown promising results; histamine has been definitely excluded as a constituent of fresh pituitary, and two distinct substances of unknown composition have been isolated. In the domain of physical chemistry

there are contributions by Dr. J. Holker on turbidity and nephelometry (Bioch. J., 1921, 15, 216 *et seq.*), and by Dr. C. Lovatt Evans (J. Physiol., 1921, 54, 353) on an error in the use of the hydrogen electrode. This error is met with when blood or other fluid containing bicarbonates is under examination, and is due to a reduction potential occasioned by catalysis, with production of formic acid from hydrogen and carbon dioxide. The same observer has also carried out an investigation of the factors concerned in the regulation of the reaction of the blood, and for this purpose employed the indicator method which he and Dr. Dale had previously devised (J. Physiol., 1920, 54, 167); this method can easily be applied to clinical uses. In bacteriology mention may be made of investigations on the nature of bacterial proteins (Dudley and Douglas), and of the new serological test for syphilis discovered by Dreyer and Ward (*Lancet*, May 7, 1921). This so-called "sigma test" can be made quantitative, and also offers several further advantages over the Wassermann test, which it appears at least to equal in accuracy.

REPORT ON THE ECONOMIC AND FINANCIAL CONDITIONS IN BRAZIL, DATED OCTOBER, 1921. By E. HAM-
BLOCH, Commercial Secretary, H. M. Embassy,
Rio de Janeiro. Pp. 65. Department of Over-
seas Trade. London: H.M. Stationery Office.
1921. Price 1s. 9d.

During 1920, a year of general economic stagnation, increased attention was devoted to developing the enormous resources of Brazil, the extension of the cultivation of cotton, oilseeds, etc. was considered, and the mineral deposits were more closely investigated. Numerous schemes are in progress or pending for exploiting the vast resources of iron ore to produce iron and steel in the electric furnace, utilising charcoal made from indigenous eucalyptus. The Itabira Iron Ore Co. is to make a port and construct a railway for the export of its ore, and to erect an iron and steel works in the State of Minas Geraes for the production of 150,000 tons of iron annually. A new furnace at Sabara (Minas Geraes) gave satisfactory results on a trial run, and a Catalan furnace at Moulevade has been acquired by a Belgian-Luxembourg group, which proposes to enlarge the works and eventually to make steel. A British syndicate is to build a large electric iron and steel works in the State of Rio de Janeiro, German interests are establishing another works in Minas Geraes, and in the same State an electric furnace is being installed at Juiz de Fora to produce steel direct from ore by an Italian process. The Ministry of Agriculture has sent an engineer and metallurgists to Europe to study the various processes of steel-making and to investigate the working of Brazilian coal and ores. Research has been carried out at the Ouro Preto School of Mines, which has been smelting ferro-manganese successfully in an electric furnace of its own design.

All the manganese mines save two are closed down, owing to the fall in price, the increased freightage and export tax, and the purchase by the United States Steel Corporation of the Morro da Mine, the largest manganese mine in Brazil. Excellent sheet mica is produced in Minas Geraes and Sao Paulo and the industry appears to be gaining in importance. A deposit of tin and one of wolfram occur near Encruzilhada (Rio Grando do Sul), but are no longer worked, and deposits of copper ore are reported to exist in large quantities in various localities. Exploration for petroleum is still being continued in the States of Alagoas, Bahia, and Parana, and is to be extended to Sao Paulo and the Amazonas basin. The Brazilian Geological Service believes that the States of Parana and Sao Paulo are the most promising in

this respect. A British Syndicate has bought an oil-shale deposit at Bella Vista in Rio Grande do Sul and anticipates the treatment of 1000 tons of shale per day within two years. Investigation of the water-power resources was begun in 1920 and important hydro-electric developments are foreshadowed.

Exports in 1920 were valued at £107,521,000, compared with £130,085,000 in 1919, the chief markets in order of importance being the United States, France, United Kingdom, and Italy. The chief exports in 1920 were, in metric tons:—Lard 11,200; hides 37,300; skins 4000; manganese 453,700; mica 68; sugar 109,100; Hevea rubber 22,900; carnauba wax 3500; castorseed 22,000; castor oil 700; raw cotton 24,700; cottonseed 23,600; cottonseed oil 3400. Imports were valued at £125,005,000 in 1920 (£78,177,000 in 1919), the principal items being:—Coal 1,120,600 metric tons; cement 173,000 t.; caustic soda 12,000 t. The largest share of the imports was derived from the United States, the value in 1920 being £52,000,000, an increase of 39 per cent. The share of the United Kingdom increased by 114 per cent. to £27,300,000, and that of Germany rose from £201,000 to £5,900,000. Although the United States has so large a hold on the Brazilian market, German competition is being felt and Belgian trade aided by a preferential tariff is also growing. The hope that British-made dyes would find a permanent market in Brazil has not been realised, and it is stated that unless the British prices are reduced the Germans will regain their hold on the market. Stocks of German dyes are in excess of future requirements. In view of the large amount of British capital—over £250,000,000—invested in Brazil and the immense resources of the country, it is hoped that British manufacturers will neglect no effort to further British trade there.

COMPANY NEWS.

SOUTH METROPOLITAN GAS Co.—Dr. C. C. Carpenter's address to the meeting held on February 8 included a reference to the question of carbon monoxide in coal gas. He described how water gas was originally introduced into gas manufacture to produce a highly self-luminous gas, thus avoiding the use of rich cannel coal which was gradually becoming scarcer and more costly, and how in recent years its utilisation had been found advantageous because surplus coke was used in its production and the quantity of gas coals carbonised was reduced proportionately. Statistics had shown that its use was not attended by danger; and during the past twenty years there had not been a single death in South London due to its poisonous character. Low-temperature carbonisation had not been adopted because it would be unprofitable to do so, but if found advisable the retorts at present used could be scrapped and new plant introduced without any serious inconvenience. At the present time experimental trials were being made on the purification of coal for carbonisation, and if they were successful there would result a collateral advantage in the improvement of the coke produced. On the subject of dye-products, Dr. Carpenter refuted the opinion that the British temperament was unsuited for the production of fine chemicals; he expressed his approval of assistance being given to that industry, and said he failed to see the difference in principle between subsidising the postal service and the chemical service, for both were essential to the welfare of the whole nation.

Dividends amounting to 5 per cent. have been paid on the ordinary stock for the year 1921.

ALBY UNITED CARBIDE FACTORIES, LTD.—The directors have issued a circular stating that they have decided to liquidate the company. Every effort was made to save the carbide works at Odda, which have been sold to the Tyssfeldene Co. for £1800, although they were valued for insurance at £350,000. This company, which held rights that made it impossible for any other bidder to come forward, claims payment of £135,000 for arrears of power rent; negotiations have been broken off, and application has been made for the compulsory winding-up of the Alby Co. The adjourned extraordinary meeting will be held on March 2.

GAS LIGHT AND COKE Co.—In his address to the general meeting on February 10, Mr. D. Milne Watson, dealing with the alleged danger of carbon monoxide in coal gas, said that the company had mixed carburetted water gas with coal gas for many years past, the percentage content of the former had not been changed since 1914, and the method of manufacture had not been altered since the passing of the Gas Regulation Act. He referred to the use of large amounts of carburetted water gas in the United States which had not been attended by danger, and stated that in this country the number of accidents due to the escape of gas was lower proportionately to the number of users than it had ever been before. It was untrue that gas undertakings were prejudiced against the adoption of low-temperature carbonisation; that process was not used because it was not economic. High-temperature distillation produced 70 therms per ton of coal, and the low-temperature process rarely more than 40 therms, and if the latter were adopted the company would have to purchase nearly double the amount of coal it was now carbonising (about 2 million tons); new plant would be necessary, and the gas would be quite unsuitable for use in ordinary gas appliances owing to its excessively high calorific power. The revenue from by-products had fallen from £1,839,000 to £2,498,000, and the coal dispute had cost the company nearly £500,000. The corner had, however, been turned, labour costs had been reduced, the price of gas lowered to 1s. 1d. per therm, and, generally speaking, prospects were excellent.

The dividend for the year on the ordinary stock was raised from 3 per cent. to £4 13s. 4d. per cent.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for February 9 and 16.)

TARIFF. CUSTOMS. EXCISE.

Australia.—Section 9 of the Customs Tariff (Industries Preservation) Act, 1921, imposes dumping duties for the protection of local industries and imports from the United Kingdom. The text of the Act is given in the issue for February 16.

Brazil.—Recent alterations in the customs tariff affect newsprint paper, bottles (stone or glass) for batteries, arc-lamp carbons, mineral oils, petroleum products, lead and tin foil, calcium carbide, and coal. Certain substances, e.g., fertilisers, arsenobenzol, salvarsan, neo-salvarsan, novarsenobenzol, materials for coal- and gold-mining companies, etc. are admitted free of duty.

Consumption duties applied under the new Budget Law affect perfumery, spirit, fine china and glassware, etc.

British Guiana.—The preferential customs tariff has been revised.

Canada.—Certificates of inspection are required for imported margarine.

Mexico.—The export duty on rubber and guayule gum has been withdrawn.

Morocco (French).—A copy of the regulations controlling the sale of butter, margarine, lard, edible oils and fats may be consulted at the Department.

New Zealand.—A supplement to the issue for February 9 gives the revised customs tariff. Preferential treatment is accorded to the United Kingdom for roughly 85 per cent. of the total trade in "competitive" goods. Many chemicals are free under the British preferential tariff, but others are dutiable at the rate of 20 per cent. *ad valorem*.

Portugal.—Imported lamp-black and solid rubber tyres are exempted from payment of import duties wholly in gold.

San Salvador.—Chloride of lime and calcium chloride may be imported duty-free.

Spain.—Import duties are shortly to be assessed on the basis of a schedule of valuations which is to be prepared and revised quarterly.

Switzerland.—Export licences are required for waste, scrap and old iron, and unmanufactured gold, silver, and platinum.

Tunis.—Edible olive oil may be exported in any quantity subject to payment of an export duty of 50 fr. per 100 kg. The export duty on phosphate has been reduced to 1 fr. per metric ton.

Virgin Islands.—A revised preferential customs tariff has been introduced.

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Australia	Heavy chemicals, tanning extracts and materials ..	156
British India ..	Antimony, copper, tin, zinc (ingots) ..	3667/T.G.
Canada	Glass battery jars, firebricks ..	161
"	Paint, varnish, enamel ..	163
"	Assaying crucibles ..	"
"	Chemicals, colours and oils for the rubber, paper, paint and other trades ..	"
Cyprus	Paint, soap	165
"	Galvanised iron sheets ..	7443/E.D.
South Africa ..	Iron and steel, tinplate, galvanised sheets	173
Belgium	Pig iron	175
Finland	Sheet iron	5011/F.R./S.C.2
France	Copper sulphate, sulphur, wax	177
Spain	Fertilisers	183
"	Pharmaceutical and heavy chemicals, crude drugs, dextrin, gums, resins, balsam, wax, vegetable oils, glycerin, fertilisers, copper sulphate, paper	185
Sweden	Chemical products, crude drugs	188
China	Paint, oils, proprietary medicines	194
United States ..	Cresote	14006/F.W./S.C.2
Argentina	Glassware for pharmaceutical purposes	198
Brazil	Heavy and industrial chemicals, coal-tar dyes ..	199
Mexico	China, leather, drugs ..	202

GOVERNMENT ORDERS AND NOTICES.

GERMAN REPARATION (RECOVERY) ACT, 1921.—The Board of Trade has issued an Order (No. 1), dated February 16, 1922, exempting from the provisions of the Act "any article being a publication in the German language which is proved to the satisfaction of the Commissioners of Customs and Excise to be a periodical publication of a German learned society, or other scientific or philosophical periodical publication." By a further Order, any article consigned from Germany direct to a manufacturer in the United Kingdom for the purpose of undergoing any process of manufacture and subsequent re-export to Germany is exempted from the provisions of the Act, provided that such article does not pass into the ownership of any person in the United Kingdom, that no payment for it is made to Germany, and that it is re-exported within one month after completion of the process of manufacture.

TRADE NOTES.

BRITISH.

Canadian Imports of Dyestuffs.—A statement in the Canadian Press that large quantities of German dyestuffs have been brought into Canada in the last few months is not confirmed by an examination of the import statistics. The following are the figures for September and October: September—U.K., 21,000 lb. (\$21,000); U.S.A., 92,000 lb. (\$91,000); Germany, 4800 lb. (\$18,000); Switzerland, 10,000 lb. (\$16,000). October—U.K., 18,692 lb. (\$14,541); U.S.A., 157,111 lb. (\$127,890); Germany, 7486 lb. (\$32,256); Switzerland, 6168 lb. (\$60,610). An examination of the returns for the six months ending September show that whereas the average price for U.K. dyes was about 60 cents per lb., that for German dyes was approximately \$3.00 per lb. This would indicate that the dyestuffs imported from Germany were mainly high-priced specialities in which there is little or no competition from British or American manufactures.

Cyprus in 1920.—The outstanding feature of the year was the phenomenal yield of olives and olive oil, the production of the latter amounting to approximately 2 million gallons, or more than twice that of any year in the last decade. Carob beans yielded well, but the vines suffered from disease and the two varieties of Egyptian cotton introduced during the year did not succeed. Cottonseed oil and cake were produced experimentally and good results obtained; private experiments are being conducted on the manufacture of sesamum oil and margarine. The experimental production of perilla-seed oil was satisfactory (*cf. J.*, 1921, 197R), and samples of essential oil distilled from *Myrophora Stoechas* and calcium citrate from Cyprus lemons were made for shipment to, and evaluation in, England. An encouraging report was made by the Imperial Institute on origanum oil produced in the island, and experiments on the production of pyro-ligneous acid by the destructive distillation of forest produce were continued. Mining prospects revived; the export of terra umbra rose by 5300 to 8000 tons, the Cyprus Mines Corporation, which is enlarging its plant at Skouriotissa, extracted 2000 t. of copper pyrites during the year, and the Lymni Mining Co. is extending its operations in the Paphos district. Asbestos was produced at Amiandos throughout 1920 and shipments were made to Switzerland and Trieste. Exports in 1920 were valued at £1,200,449, of which the United Kingdom took 21 per cent. and

* Canadian Trade Commissioner, 73, Basinghall St., London, E.C.2.

British possessions 36 per cent. Imports were valued at £2,068,756; the share of the British Empire fell from 81.2 to 68.9 per cent.—(*Col. Rep.-Ann.*, No. 1093, 1921.)

FOREIGN.

The Norwegian Nitrogen Company.—During its last financial year the Norsk Hydro-elektrisk Kvaestof A.S. incurred a loss of 1.31 million kroner (krone=1s. 1½d. at par, now 9d.), compared with a net profit of 24.86 million kr. in the previous year, and its subsidiary A.S. Rjukanfos made a net profit of 0.61 mill. kr. (18.66 mill. kr.). Sales declined heavily, and although prices were lowered the demand for nitrogen products did not improve appreciably, and large stocks accumulated. Sales of the company's special products, sodium and ammonium nitrites, were lowest during the first half of 1921. It is recognised that ability to compete in the world's markets can only be attained by reducing costs, especially wages and taxes. Some months ago the company increased its loan capital by 15 million kroner.—(*Chem. Ind.*, Jan. 23, 1922.)

New Chemical Companies in Japan.—Eighty new chemical companies, representing a total capital of 34,025,000 yen, were formed in Japan during the first eight months of 1921, and the seven companies formed in August had a combined capital of 4,650,000 yen (yen=2s. ½d. at par, now 2s. 3d.). Two companies raised their capital by 4½ millions, and others issued debentures amounting to 5 millions, so that the total sum invested during the period was 63,525,000 yen, of which 1.7 million was raised in Korea. Capital invested during the same period in recent years has been as follows (in million yens):—1917, 72.18; 1918, 113.62; 1919, 138.72; 1920, 230.91; 1921, 63.53.—(*Chem. Ind.*, Jan. 16, 1921.)

REVIEWS.

CANE SUGAR: A TEXT-BOOK OF THE AGRICULTURE OF THE SUGAR CANE, THE MANUFACTURE OF CANE SUGAR, AND THE ANALYSIS OF SUGAR-HOUSE PRODUCTS. By NOËL DEERR. *Second edition.* Pp. viii.+644. (London: Norman Rodger. 1921.) Price 42s. net.

The author of "Cane Sugar" has had a long and varied experience of the industry of which he treats and there are few so well qualified to write on this subject. The first edition of the book, published in 1911, has been a standard work on the cane-sugar industry since that date and the publication of a second edition only ten years later is proof of its great value. The author makes a striking feature of the historical development of the various branches of the subject, stating, very justly, in the preface that "an account of the development of the train of thought in invention is not without an immediately utilitarian value." This method of treatment also adds greatly to the value of the book as a work of reference and does not unduly increase its size, since much of the history consists of references to, and brief comments on patents.

Although the book has been very largely rewritten and amplified, the arrangement adopted in the first edition has been adhered to. The botany and agriculture of the cane and the pests and diseases to which the cane is liable, are treated at some length, nearly one-third of the book being devoted thereto. The chapter dealing with varieties of cane, which is illustrated by a number of excellent coloured plates, shows that the planters are fully alive to the importance of investigation in this direction, and it is also shown that the utmost

scientific skill is called in aid against the various cane pests. During the past few years great progress has been made in checking the ravages of these pests by the introduction of suitable parasites; the case of the borer beetle (*Rhabdocnemis obscurus*), quoted by the author, is a notable achievement of this kind. This pest had caused much damage in Hawaii; the account of the discovery of the original habitat of its parasite (a tachinid fly) in New Guinea, the acclimatisation of the parasite by geographical stages to Hawaii and consequent checking of the ravages of the host constitute one of the romances of science.

The work in the factory, to which of course the greater part of the book is devoted, is very ably described and explained, the theoretical considerations underlying the various processes being most exhaustively treated. The chapters on defecation and sulphitation show that considerable advances have been made in these processes during the past ten years. The Thomas-Petrie process, in which the defecation mud is distributed over the bagasse in the milling train with consequent elimination of the filter-press station, deserves a more detailed account than that given by the author, since it appears to have proved of considerable value in Queensland. A useful account is given of recent work on the specially-prepared vegetable carbons for decolorising sugar juices. These preparations are very much more active than ordinary bone charcoal, but the author writes with some reserve as to their application in the sugar industry and evidently considers that further experience of their efficiency is required. The principles and practice of evaporation, sugar-boiling and centrifuging are dealt with in great detail, and the various kinds of multiple-effect and other apparatus are described with full reference to patents.

The chapters on the analysis of sugar-house products embody recently improved methods except in one instance, viz., the iodometric determination of aldoses; for this Romijn's original method is given although much more expeditious and convenient modifications of it have been described in recent years. The book concludes with a short account of the fermentation of molasses and manufacture of rum, and there are appended an extremely full, classified bibliography and a very interesting outline of the history of sugar.

Considering the enormous mass of information in the book, the errors are few and mostly unimportant, though one or two are serious. Thus, from a statement on p. 262 (4th and 3rd lines from bottom) it might be supposed that cane sugar is inverted by enzymes in general, and on p. 473 (lines 20 and 21) the description of an asymmetric carbon atom as "an atom which is at least quadrivalent," is, to say the least, misleading.

The book is well printed and copiously illustrated, and should be of the utmost value both to the planter and to those concerned in the cane-sugar industry.

LEWIS EYNON.

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918, No 4. THE THEORY AND PRACTICE OF ACID-MIXING. Pp. 93. Ministry of Munitions and Department of Scientific and Industrial Research. (London: H.M. Stationery Office. 1921.) Price 12s. net.

In the present volume Mr. W. Macnab continues the compilation of results of scientific and industrial value contained in the records of operations carried out in national factories during the war. The field of operations covered is somewhat narrow, and it may appear to some that for this reason the general treatment of the subject is too detailed. When, however, it is remembered that at the Queen's Ferry Factory alone TNT was being manufactured at the

rate of 100 tons per day, involving the preparation of some 650 tons of mixed acid and the handling of the corresponding quantity of spent acid, it will be realised that calculations and preparation of tables to facilitate normal work were essential, and additional tables to meet abnormal conditions desirable. The subject matter, which deals mainly with acid mixings, etc. involved in TNT manufacture, is divided into three sections:—(1) Acid-Cycles, Acid-Balances, and Control of Plant-Output. (2) The Position of the Acid-Mixing Plant in the Acid-Cycle and the Procedure adopted in Mixing. (3) Plant and Process for Acid-Mixing.

The acids cycle for nitroglycerin-manufacture follows very closely that for TNT; the cycles for guncotton and nitrocellulose on the other hand have their own characteristics, which are separately dealt with on pages 25–30. Naturally the treatment of the subject is based on conditions at Queen's Ferry, where oleum and R.O.V. were produced by the contact process, spent acid was denitrated and after denitration concentrated in Gaillard towers. Under these conditions the necessary strength of Gaillard acid was calculated to be 90.4 per cent., and in the various tables the strength is taken in some cases at 90 and in others at 91 per cent. In Report No. 3 it is stated (page 81) that "On account of changes in the working of the TNT-acids-cycle it had been necessary to raise the concentration figure from 90.5 to 93 per cent. H_2SO_4 ," and in the present volume (page 3) one reads "For reasons which need not be discussed here it was decided not to use at Queen's Ferry the nitration-scheme in which the waste acid from the trinitration stage is revived with nitric acid and utilised for the mononitration stage."

Such conditions must always be borne in mind, since the conditions decide the choice of tables. The method of preparing and using the necessary tables and diagrams is fully indicated in the text and it is the Queen's Ferry method of control rather than the actual Queen's Ferry figures that should receive attention.

In Section I we find a record of the TNT-acid-cycle covering the production of oleum, nitric acid, etc., together with the composition of mixed and spent acids. The quantities of these consumed or produced per unit of product over a given period are disclosed on the flow sheet, and it is from such a flow sheet, covering a sufficiently long working period under standardised conditions, that the "Acids-Balance" is derived. Whilst the flow sheet gives average quantities, the "Acids-Balance" should allow for all variations in plant efficiencies and abnormalities in the working of the cycle. "The Acids-Balance represents for the mixing-plant an ideal to which it is expected to approximate as closely as possible." Variations will be found necessary from time to time following changes in efficiency of plant-working, accidents in mixing, temporary stoppages of denitrating plants, etc. With the acid-balance once established it becomes a simple matter to decide from stock figures (mainly tank-dips) which particular plant-section requires special attention. The diagrammatic method of showing all stocks in terms of main product, and the curves showing excess or deficiency from day to day will no doubt appeal to many.

The calculation of the acids-balance, the factors necessitating variation in degree of concentration, the calculation of mixes, calculation of dopes, possible dopes and practical methods of doping are fully discussed in Sections I and II, whilst in Section III are described the plant and process for acid-mixing.

Much of the subject matter is reminiscent of the lecture theatre; it proceeds, however, much beyond this and shows how far theoretical figures have to yield to practical conditions. Many points of real practical importance are to be found, more par-

ticularly in Section III, where the designs of various units of plant and general lay-out are given in detail. On pages 36–40 are given the reasons deciding the strength of spent acid; of the procedure followed in working off the weak nitric acid recovered in the denitration process, together with interesting figures showing the effect, in output of the main product, of variation from the standard deciding the strength of spent acid; for the procedure adopted are given on page 46. The calculations and observations regarding speed of mixing and cooling of the mixed acids are of general interest, as also are details of pipe sizes as affecting rate of flow, and more particularly wear and tear of pumps.

J. T. CONROY.

ELEMENTARY CHEMICAL MICROSCOPY. By ÉMILE MONNIN CHAMOT. *Second edition.* Pp. xv.+479. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1921.) Price 25s. net.

This book, based on the author's course of instruction in chemical microscopy at Cornell University, is intended as a text-book for students. The first edition appeared in 1915, and in this second edition the work has been partly re-written and enlarged. A good, readable account is given of the general principles involved in the apparatus and various methods employed. Since the microscope is extensively used for general purposes and as there are many types of instruments designed for special purposes, it is evident that the subject may have a pretty wide range. A good idea of the various matters touched upon in the book may be gained by a glance through the 162 excellent and clearly-drawn text-figures. Objectives and oculars, different types of stands, illuminating devices, various accessories and tools, etc., are described. Special chapters are devoted to metallurgical microscopes (and the preparation of sections of opaque objects), polarising microscopes, and ultra-microscopes. Other chapters deal with the measurement of lengths and areas, determination of melting- and sublimation-points, of refractive indices, etc.

The larger portion (130 pages) of the book deals with the methods of microchemical qualitative analysis and the characteristic reactions of the common elements and acids. This is presented in text-book form for elementary students; but for purposes of reference, to meet the needs of advanced students and professional chemists, the same author has in preparation a "Handbook of Microscopic Qualitative Analysis."

There is one point regarding the importance of microchemical analysis that does not appear to be mentioned by the author—at least it is not emphasised. When determining the mineral constituents of an ore, a common procedure is to analyse pieces of some size broken off more or less at random; and it has often happened that the physical characters have been determined on fragments of one kind of material, whilst the chemical composition has been determined on those of another kind, or even on two or three kinds mixed together. By the microchemical method this confusion can to a large extent be avoided. By taking a fragment about the size of a pin's head there is more chance that a single kind of material is being dealt with. Its homogeneity can be scrutinised under the microscope, and its optical characters determined. The same fragment can then be dropped into a heavy liquid to determine its density; and afterwards it can be submitted to a microchemical examination, when probably a single confirmatory test is all that will be required to complete the determination. For the quick determination of minerals this is undoubtedly the best method.

I. J. SPENCER.

OBITUARY.

JAMES FRANCIS BOTTOMLEY.

By the death of Dr. Frank Bottomley at the early age of 47, science and scientific industry have suffered a deplorable loss. Based on his researches he initiated and established a unique industry for the manufacture of silica glass, or, as it is now better known, of "vitreosil." Dr. Bottomley's genius, his indefatigable resource and determination have made the acid-resisting and heat-resisting properties of silica available to the practitioner in the laboratory, and succeeded in demonstrating how it could be moulded into stills and condensation plant for the manufacture of nitric acid, or utilised in the production of the plant used for the concentration of sulphuric acid. It is impossible, without seeming exaggeration, to speak of these industrial uses of "vitreosil," but if we recall the fundamental importance of nitric and sulphuric acids to the manufacture of propellants and explosives and the shortage of acid-resisting ware, then do we begin to realise something of the important services Dr. Bottomley rendered to his country during the great war.

In the early years of this century, works were established at Wallsend-on-Tyne by the Thermal Syndicate, Ltd., in which the manufacture of the multifarious articles and appliances was carried on under the directorship of Dr. Bottomley.

On several occasions I was privileged to witness the various operations by which pure sand is converted into "vitreosil" and fashioned into tubing, crucibles, basins, etc., and to admire the ingenious methods by which electricity is applied to bring the silica into the state of plasticity necessary for moulding it into the required shapes. The devices used for finishing and glazing crucibles and the like, and those for converting the rough product into articles comparable in appearance and capable of similar usage to those fashioned from quartz, all served to impress me with the skill, knowledge and resource of the man who not only designed the processes of manufacture, but who had the no less arduous task of training the workers in these unwonted operations. Altogether, a great and remarkable achievement, and one's interest and admiration were enhanced by the quiet restraint and modest manner in which Dr. Bottomley described and explained the various operations.

James Francis Bottomley was born in Glasgow on February 19, 1875, the second son of James Thomson Bottomley, LL.D., F.R.S., one time assistant to his uncle, Lord Kelvin. So Dr. Frank Bottomley was grand-nephew of Lord Kelvin, and also of Prof. James Thomson, LL.D., F.R.S., professor of Civil Engineering at Glasgow University. He was a delicate child, never of robust constitution, and frequent illnesses interfered with his regular school education; but despite these disadvantages his persistence and courage helped him to face the struggle of life undaunted by physical difficulties. He became a student at Glasgow University, devoting himself especially to chemistry, subsequently continuing his studies under Victor Meyer at the University of Heidelberg, where he graduated as Ph.D. Returning to Glasgow he obtained in 1898 a research scholarship, the first year of which he spent at Glasgow, the second at Owens College, Manchester, where he was elected a Research Fellow, and the third year Dr. Bottomley worked with Sir William Ramsay at University College, London.

In 1913 Dr. Bottomley married Dorothy, younger daughter of Captain Couves, formerly of Gravesend, now residing at Morpeth, at whose house he died on January 16 from pneumonia following an attack

of influenza. A man of a lovable nature, retiring disposition, a reliable and faithful friend, he was held in high esteem by his employees, inspiring in them a confidence and good will which helped to frustrate the attempts made by German competitors to obtain information as to the methods of working used at the Wallsend factory.

P. PHILLIPS BEDSON.

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- TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918. No. 6. SYNTHETIC PHENOL AND PICRIC ACID. Pp. 97. Ministry of Munitions and Department of Scientific and Industrial Research. (London: H.M. Stationery Office. 1921.) Price 15s.
- THE FAILURE OF METALS UNDER INTERNAL AND PROLONGED STRESS. A General Discussion held on April 6, 1921, by the Faraday and Other Societies. Edited by F. S. SPIERS. (The Faraday Society, 10, Essex St., W.C. 2. 1921.) Price 10s. 6d.
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- ANNUAL REPORT ON THE MINERAL PRODUCTION OF CANADA DURING 1920. Pp. 80. Department of Mines, Canada. (Ottawa: F. A. Acland. 1921.)
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- ELEVENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF MINES FOR THE FISCAL YEAR ENDED JUNE 30, 1921. Price 10 cents.
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- BARYTES AND BARIUM PRODUCTS IN 1920. By G. W. STOSE.
- NATURAL-GAS GASOLINE IN 1919. By E. G. SIEVERS.
- GOLD, SILVER, COPPER, LEAD AND ZINC IN CALIFORNIA AND OREGON IN 1920. By C. G. YALE.

BIOCHEMICAL METHOD.*

A. HARDEN.

In the study of biochemistry, although some of the problems can be solved by the ordinary methods of chemical research, special difficulties arise from the circumstance that in many cases the substances whose effects are under investigation cannot be isolated. This is true, for example, of the whole body of work dealing with enzymes, those mysterious agents by which the most complicated changes are brought about at practically constant temperature and without detriment to the delicate tissues of the living organism within which they occur. As a consequence of this the concentration of the active substance is never known, and only comparative experiments are possible. Further, since the enzyme can never be freed from accompanying matter it is impossible to adhere to the golden rule of experimentation—only to vary one factor at a time. Dilution of an enzyme solution, for example, not only changes its concentration, but also that of all the accompanying compounds, and, moreover, usually alters the degree of dispersion of some of the components of the system as well as the hydrogen-ion concentration. Thus in the case of many diastases, this introduces a serious complication, since their action depends on the concentration of the salts in the medium, which is, of course, altered by the dilution. In the same way the usual control of an enzyme reaction is carried out with a boiled solution of the enzyme, but it must be remembered that here again boiling does much more than merely inactivate the enzyme.

All the difficulties which attach to the investigation of enzymes are felt in equal measure in work dealing with vitamins, and are here intensified by the fact that up to the present it is only by experiments on animals that information can be gained on this subject. To the uncertainties of concentration and the effect of accompanying substances is added the great variation that exists between individual animals which brings with it the necessity for numerous experiments before any valid conclusions can be reached. Very real difficulties are also the length of time required before a result is attained, and the not remote possibility that the experimental animal may fall a victim to some one of "the ills that flesh is heir to" quite unconnected with the experiment in progress.

These difficulties have stood greatly in the way of quantitative work with the vitamins without which any very extended advance is impossible. This is particularly evident in the attempt to ascertain the quantitative distribution of the principles and in the study of the effects upon them of varying temperatures, drying, oxidation, etc. It is now well recognised that three different vitamins exist which are conveniently termed vitamins A, B and C. The estimation of the amounts of B and C present in various foodstuffs, or in the same preparation before and after certain definite treatment, may be carried out by taking advantage of the fact that the absence of each of these from the diet of an appropriate animal produces a definite disease, the symptoms of which can be recognised and which ultimately leads to the death of the animal, whereas the administration of the vitamin to an animal already suffering from the disease cures it. Experiments can, therefore, be either curative, the minimum dose being determined which is required on the average to cure an animal, or protective, in which case the minimum dose which must be

administered daily in order to prevent the occurrence of these symptoms is found. Employing this method, pigeons are used for the estimation of vitamin B and guinea pigs for that of vitamin C. The most accurate results obtained in this way, such as those obtained at the Lister Institute on the relative antiscorbutic and antineuritic potency of foodstuffs, have probably an error of 25–50 per cent. Slightly better results can be obtained with vitamin C, by the method introduced by Zilva and Miura, in which the minimum dose is determined which is sufficient to produce definite growth for a definite time in an animal which has been exposed, also for a definite time, to a complete deficiency of this vitamin. Even in this case these authors only venture to use doses differing by as much as 20 per cent., so that the error is still very considerable. The animals used in this case are rats, and these can also be used for the estimation of vitamin B by determining the minimum dose required to maintain normal growth.

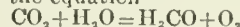
It will be seen that at present only large changes produced by variation of conditions can be observed. In spite of this, much has been learned about the distribution of the vitamins and some of their most salient properties (*cf.* J., 1921, 79 *ff.*).

It has thus been found that of the three vitamins B is least affected by the various processes involved both in the commercial preparation of foodstuffs and in the cooking of food, as it is not easily affected by either moderate rise of temperature or oxidation by atmospheric oxygen. Vitamins A and C, on the other hand, although apparently fairly stable when the substances containing them are exposed to temperatures of 100° C., or even, in the case of A, of 120° C., are readily inactivated by exposure to air at these temperatures for a short time, or for a longer time at a lower temperature. Until questions such as these are settled with all possible accuracy, it is impossible to lay down hard and fast rules as to what may or may not be done safely in the way of sterilising and preserving food, a subject of vast importance in relation to the economic utilisation of our available supplies and to the provision of a sufficient and adequate diet for all classes and ages of the community.

THE PHOTO- AND PHYTO-SYNTHESIS OF PLANT PRODUCTS.*

I. M. HEILBRON.

In a paper previously communicated to this *Journal* (Baly and Heilbron, J., 1921, 377 *ff.*) it was shown that in the equation

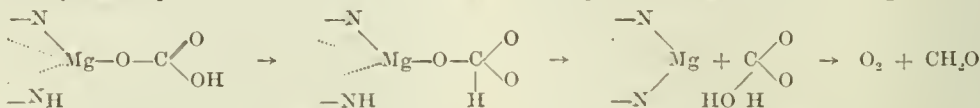


the sum of the energy contents of the products is vastly greater than that of the reactants, and consequently formaldehyde can only be formed provided energy is supplied to the initial system. This was carried out by means of light of very short wavelength, using the quartz mercury-lamp as source. It was further proved, moreover, that as formaldehyde itself absorbs ultra-violet light of $\lambda = 290 \mu\mu$, polymerisation to sugar would immediately ensue unless precautions were taken to cut out these active rays, and this was done by introducing paraldehyde into the carbonic-acid solution, which substance absorbs the long-wave ultra-violet light and thus acts as a protector for the formaldehyde when formed. As, however, the synthesis of sugar in the green leaf of the plant takes place in ordinary day-

* Abstract of an address delivered before the Local Sections of the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colourists, and the Manchester Literary and Philosophical Society, in Manchester on January 6, 1921.

* A paper read before the Liverpool Section of the Society, February 17, 1922.

light where light of wave-length less than $\lambda = 350 \mu$. is completely absent, the question remaining to be solved, admitting the formaldehyde production as an intermediate stage, was how could the plant utilise light of the visible spectrum to bring about reaction. The solution to the problem was shown to lie in the application of the Baly theory of photocatalysis (*loc. cit.*), and in presence of malachite green or *p*-nitrosodimethylaniline, an aqueous solution of carbon dioxide readily forms formaldehyde when exposed to light behind a thick plate-glass screen, which effectively cuts off all ultra-violet rays. It should be noted that the formaldehyde synthesised in this way is necessarily in the activated form of high energy content and consequently can condense directly to form sugars. As is well-known, ordinary formaldehyde is incapable of such polymerisation by itself, but on exposure to ultra-violet light, when energy of its characteristic frequency is absorbed, condensation to reducing sugars readily takes place. In order to connect



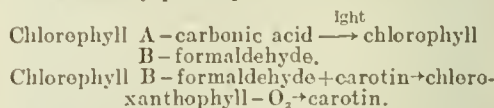
these experiments carried out *in vitro* with the reaction in the green leaf itself, it is necessary, in the first place, to have some knowledge of the chemical character of chlorophyll which acts as the natural photocatalyst. This pigment has been very fully investigated by Willstätter and has been shown to consist of two substances, chlorophyll A ($\text{C}_{55}\text{H}_{72}\text{O}_5\text{N}_4\text{Mg}$) and chlorophyll B ($\text{C}_{55}\text{H}_{70}\text{O}_5\text{N}_4\text{Mg}$). Invariably associated with these are two other pigments, the so-called carotinoids, one being a hydrocarbon, carotin, $\text{C}_{40}\text{H}_{56}$, and the other is the pigment known as xanthophyll with formula $\text{C}_{40}\text{H}_{58}\text{O}_2$. The average percentage amount of the four pigments calculated on dry leaf, as also the molecular proportions in which these normally occur in land plants, is shown in the following table.

	In 1 kg. dry leaf.	Approximate molecular proportions.
Chlorophyll A	6.22	3
Chlorophyll B	2.26	1
Carotin	0.55	{ 1 (usually rather less)
Xanthophyll	0.93	

From an elaborate study of the assimilation of carbon dioxide by the green leaf, Willstätter has been able to prove definitely that during the process the ratio of chlorophyll A to chlorophyll B remains constant, but that, under intensive assimilation, the ratio of carotin to xanthophyll decreases, an effect unconnected with respiratory action. He also found that the rate of assimilation varies very extensively in young, fully-grown, and old leaves, and also that the influence of temperature on the one hand, and intensity of illumination on the other, differs widely in leaves rich and poor in pigment. In the latter the effect of temperature is negligible, but increase of light intensity is an important factor. On the other hand, with leaves rich in pigment, the reverse is essentially correct. Another fact of quite outstanding importance, ascertained by Willstätter, is, that for all plants the ratio between the carbon dioxide absorbed and the oxygen transpired is unity. This can only result provided that the carbon compound synthesised in the first instance is formaldehyde (or a polymer) for in all other cases this assimilatory coefficient would be greater than unity. Willstätter also proves by means of experiments carried out with colloidal chlorophyll solutions *in vitro* that this pigment, dissolved in non-aqueous solvents, is inert to dry carbon dioxide, but in colloidal aqueous solution, as also in the leaf itself, is able to combine with carbonic acid in such

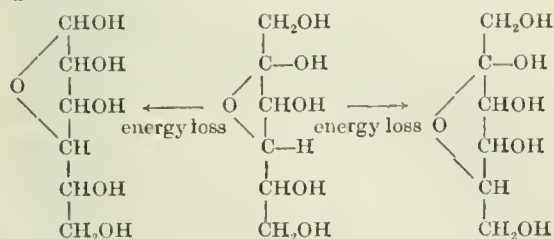
a manner as to remove the magnesium from the chlorophyll as basic magnesium carbonate. He has observed, however, in these reactions, especially when dealing with the leaf, the formation of an intermediate addition complex from which the carbonic acid can again be dissociated without affecting the chlorophyll molecule. A chlorophyll-carbonic-acid complex such as this will ensure the identity of infra-red frequencies necessary for the photocatalytic action, and consequently these experiments confirm in the strongest manner the correctness of the views expressed regarding the mechanism of the synthesis. From the results of the experiments regarding the influence of temperature and light on the rate of assimilation, Willstätter has come to the conclusion that there must be present in the protoplasm an enzyme capable of carrying out the deoxidation of the chlorophyll-formaldehyde complex which is assumed to be formed through rearrangement of the chlorophyll-carbonic-acid complex under the influence of light:—

It is an undoubted fact that enzyme action plays a very important rôle in the chemistry of natural products, but as far as one can judge at present it does not appear to follow as a necessary corollary in order to account for the deoxidation of the chlorophyll-formaldehyde complex. It is curious that, although Willstätter proves with singular ingenuity the presence of the two chlorophyll components in the pigment, he seemingly disregards this point in his ultimate explanation. Further, despite his proof of the increase of xanthophyll during intensive assimilation, he nevertheless argues that the carotinoids play no direct part in the actual photosynthesis. This conclusion was arrived at by ascertaining that photosynthesis would proceed equally readily in their absence, as evidenced by the insertion of a screen containing a 1 per cent. solution of potassium dichromate between the light and the assimilation chamber. It has now been proved, however, from new work carried out in Liverpool that this solution is probably not an entirely effective screen for the rays absorbed by either of the carotinoids. It is inconceivable that Nature would build up four distinct colour pigments, each capable of absorbing energy of characteristic frequency, unless they were intended to play some vital part in the photosynthetic process, and it seems reasonable to assume as a tentative explanation that all four pigments are in complete equilibrium with one another according to the following scheme, and that each necessarily participates in the reaction:—



In this connexion it is necessary again to emphasise the point that, so long as the ratio of the carbon dioxide absorbed to oxygen evolved remains constant, any shift of the equilibrium between chlorophyll A and B must necessarily remain undetected. It might be suggested that such an explanation in reality only pushes the difficulty of accounting for the transpired oxygen one stage further, and it has yet to be shown how it is in turn eliminated from the xanthophyll. This point is at present being investigated in Liverpool. It is suggested as a working hypothesis that, under the influence of light, the energy absorbed by the xanthophyll may very greatly increase the oxygen dissociation pressure of the complex and thus bring about the reverse process with regeneration of carotin.

A closer investigation of the reducing sugars, of which large quantities have been prepared, has now been made, with the result that it has been definitely established that the photosynthesis of carbohydrates in this way results in the formation of only hexose sugars. This point is undoubtedly one of quite outstanding importance which must very considerably modify our views regarding the photosynthetic processes that ensue after the preliminary photosynthesis. It seems as if the activated formaldehyde has the predisposition for polymerisation to the six-carbon unit, even when the experiments are conducted outside the living cell. It follows, therefore, that attempts to look for formaldehyde itself in the green leaf are obviously useless, for this predisposition which exists in the experiments carried out *in vitro* will undoubtedly be augmented under the ideal conditions existing within the chloroplastid where, moreover, concentration conditions would readily favour maximum condensation. It has often been assumed that trioses might be a definite stage in the condensation of formaldehyde, but these are not actually found in the plant nor are nonoses, which could equally well be anticipated on the assumption that hexose formation produced from the three-carbon unit. It is more probable that the three-carbon system so frequently met with among plant products results from the disintegration of the six-carbon system, and in this connexion the work of C. L. Neuberger and his collaborators is of outstanding interest. Further support to this view, that the freshly synthesised active formaldehyde condenses directly to a hexose, is afforded from a consideration of the generally accepted view that the first sugar detected in the leaf is sucrose, whilst at the same time starch formation occurs within the chloroplastid as a temporary reserve material. With regard to the constitution of sucrose, attention must be drawn to the recent work on the structure of this carbohydrate, wherein it has been established that the fructose part of the molecule is present in an active labile form containing either an ethylene-oxide ring (Haworth and Law, Chem. Soc. Trans., 1916, 109, 1314) or a propylene-oxide ring (Boeseken and Couvert, Rec. trav. chim., 1921, 40, 354). In either case the active sugar would rapidly pass, with loss of energy, into the stable form of the ordinary butylene-oxide fructose or, equally possible, into butylene-oxide glucose.



The latter would thus become the source of starch formation within the chloroplastid, whereas cane sugar would be formed between one molecule of the stable glucose and one molecule of freshly synthesised active fructose. The consensus of opinion seems to be that the quantity of fructose in the leaf is almost invariably in excess, which fact is readily explained on the above assumption that an active keto-hexose is the sugar first synthesised. If this view is correct, then the only process in the building up of the innumerable complex substances in plant synthesis must be derived from this source, and hence the function of the chlorophyll is narrowed down to the very definite operation of sugar formation.

The next question to be considered is that regarding nitrogen assimilation in the plant, a process

obviously closely bound up with carbohydrate synthesis. This problem is also under investigation, two parallel lines of attack being in progress, one through the medium of potassium nitrate, carbon dioxide and formaldehyde, the other starting from ammonia as the source of nitrogen. O. Baudisch has stated that a solution of potassium nitrite and methyl alcohol combine to form formhydroxamic acid under the influence of ultra-violet light, oxygen being split off from the nitrite molecule after a short time, which then oxidises the methyl alcohol to formaldehyde (Ber., 44, 1009, 1911).



This experiment has now been confirmed, it being definitely ascertained that, in presence of light, potassium nitrate or nitrite unites with formaldehyde to yield formhydroxamic acid. Moreover, as no reaction takes place in absence of light, even on heating, the truly photosynthetic character of the reaction is definitely proved. Another interesting fact which has also been elucidated in the course of these experiments is that, in presence of excess formaldehyde, sugars are formed concomitantly with formhydroxamic acid, thus affording direct evidence that carbohydrate formation and nitrogen-carbon combination can take place simultaneously and independently. It can therefore be assumed with a very high degree of probability that a similar reaction takes place within the cell through the medium of active formaldehyde, such reactions being the only true photosynthetic processes in plant synthesis. In a further paper Baudisch claims (Ber., 1913, 46, 115) to have obtained evidence of the formation of an alkaloidal compound, and in the course of the experiments mentioned above distinct evidence of the formation of such substances has been obtained.

The final question in any attempted solution regarding photosynthesis of plant products must necessarily devolve itself into finding an answer, speculative though it may be, as to the means by which, starting from a keto-hexose, other substances may be produced. In this respect it seems to the writer that too little attention has been paid in the past to the close relationship which undoubtedly exists between the sugars and heterocyclic furano compounds. It is a well-established fact that hexoses, especially keto-hexoses, readily yield ω -hydroxymethylfurfuraldehyde by loss of water, a reaction which might certainly take place within the cytoplasm, especially during the daytime when the water concentration is extremely low. Assuming the actual formation of this compound, it is obvious that on the one hand reduction would yield a basis for the formation of the methyl pentoses, and from these, by perfectly normal reactions, one could formulate methods for the building up of such complexes as the carotinoids, terpenes, caoutchouc and phytol. On the other hand, oxidation of ω -hydroxymethylfurfuraldehyde, followed by ring rupture, leads in a highly suggestive manner to a whole host of products, including the pentoses, many of which are actually isolated as definite entities in the plant. Finally, the finding of an alkaloidal type of substance in such a simple case as the interaction of formaldehyde and potassium nitrite opens up a vast vista of possibilities for protein and alkaloidal photosynthesis. The photosynthetic formation of formhydroxamic acid and the possibility of this substance then further condensing with active formaldehyde, and also with itself, opens the door to many fascinating speculations regarding the formation of nitrogen compounds of both the aliphatic and cyclic series. Again, the presence of ammonia or methylamine as easily accessible substances becomes capable of ready interpretation in the light of the formation of the photosynthesised formhydroxamic acid, and these, in presence of furanes, could readily react to form nitrogen bases under

actual photosynthetic conditions. Experimental work undertaken in the hope of obtaining further evidence in support of these views is in active operation both in the Inorganic and Organic Laboratories of this University.

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IMPRESSIONS OF THE BRITISH INDUSTRIES FAIR.

STEPHEN MIALI.

The Chemical Industry of this country is in a state which causes us all a good deal of anxiety. During the last few years our chemical manufacturers, and we must include in this phrase their scientific advisers, have undertaken many new tasks and successfully solved a number of very difficult problems. We have had for a century a flourishing industry in heavy chemicals, and recently we have developed an aniline dye industry and a fine chemical industry which should in time be of great value. But at the very moment when these are at the critical point in their growth they are faced with difficulties which are without parallel in human experience. The poverty of the world, the unemployment at home, and the lack of foreign trade, menace the very existence of new enterprises.

The State has done a little to help these young developments, and recent legislation, though not on the lines which many of us wished, is evidence of the importance to which they attain in the public estimation. The exhibition in Shepherd's Bush, known as the British Industries Fair, affords another instance of the efforts of the State and of Chemical Industry to call the attention of the public to the achievements of the past and present and the necessities of the immediate future.

With some important exceptions the Chemical Industries are well represented at the fair. The different stands are attractive and pleasantly arranged; bottles of various coloured liquids, heaps of crystals, and fabrics dyed in all the hues of the rainbow and many others besides, are displayed with all the art and ingenuity possible.

The dyestuff industry is represented by the British Dyestuffs Corporation, the British Alizarine Company, Scottish Dyes, Ltd., L. B. Holliday and Co., J. W. Leitch and Co., the Southdown Chemical Company, Hickson and Partners, Grays Dyes and Colours, J. C. Oxley, Ltd., James Robinson and Co., Ltd., Sharps of Edenfield, Williams Brothers of Hounslow, and the Alliance Colour Co. So far as one can judge from this fair, the firms just mentioned manufacture between them a fairly complete range of synthetic dyes; their chemists and works managers have not been inferior in knowledge and skill to those employed by foreign firms, and many of the most startling achievements of the great German factories have been equalled by the British manufacturers. For dyeing furs, cotton, wool, silk, leather, paper and other materials British-made goods of first-rate quality can be obtained. Provided the orders will come along, this industry can be made prosperous; to ensure this a closer co-operation between the scientific and the commercial sides must be brought about; in too many cases those who sell can hardly understand the language of those who use the dyes, and this industry can never succeed until it is run by commercial men with some scientific feeling and sympathy and by scientific men with some idea of the needs of modern industrial conditions. The fair shows us that the

problem of making a large range of satisfactory dyestuffs is already solved.

The manufacture of intermediates, the raw materials of the dyestuff maker, seems to have been undertaken with equal success. The South Metropolitan Gas Co., the Gas Light and Coke Co., Bowdler and Bickerdike, the Graesser-Monsanto Co., Burt, Boulton and Haywood, and The Midland Tar Distillers exhibit not only a great number of such intermediates, but also disinfectants, fertilisers and other products. It is not necessary to describe at length the sulphate of ammonia shown by the South Metropolitan Gas Co., the Prussian blue of the Gas Light and Coke Co., or the phenol of the Graesser-Monsanto. It is safe to say that the products made by the group of manufacturers who specialise in these derivatives are as excellent as the buyers require. What seems to be lacking is that good conceit of themselves with which all manufacturers should have been endowed. The makers of dyestuffs and their raw materials have done finely and the public should know it. The public should also know in what a perilous state the industry is. Let the manufacturers bring their band with them next time they appear in public. What is wanted is not so much the dying notes of the soft complaining flute as the trumpet's loud clangour and the double double double beat of the thundering drum.

But if some suffer from too little advertisement the makers of drugs and pharmaceutical chemicals are not in that category. British Drug Houses, W. J. Bush and Co., Boots Pure Drug Co., Evans, Lescher and Co., Howards, Morsons, Tyrers, Boake, Roberts and Co., May and Baker, Stafford Allen, Mr. J. L. Roso, and Whiffens exhibit enough tonics to cure every ailing man in London and enough poisons to kill every sound one. They exhibit beautiful bottles of alcohol and annatto, aloin and theobro, and garlic juice and guaiacol, and orange oil and eugenol, acetic anhydride and apomorphine, ethyl pelargonate and euonymin, acetophenoxime and zinc peroxide, methylene ditannin and others beside. It appears to be a wonderful collection; only an expert can judge of these things, but there they are in their thousands, with notes on how to test their purity and how to use them for the benefit of mankind; there are also displayed hundreds of synthetic reagents whose names would extend from here to Mesopotamy.

This active industry, where will it be five or ten years hence? We may be confident that if it lives for the next five years it should become well established and flourish, root and branch, for ever. But during the next two or three years how many perils will environ the capital invested in the fine chemical industry, and the labour engaged in it!

Let us pass on to the stand of the United Alkali Co. which makes a feature of liquid chlorine for the sterilisation of water, to that of Hopkins and Williams whose exhibit includes a number of thorium and uranium compounds, and to that of Laporte of Luton who takes a prominent place in the manufacture of hydrogen peroxide. Albright and Wilson make a specially fine show of phosphorus and its compounds and of some other chemicals whose purity is unrivalled. Johnson and Sons show photographic chemicals, infinite riches in a little room.

Pigments and some other articles are shown by Orr's Zinc White, Ltd., the St. Helens Smelting Co., Frederick Allen and Sons, and Keeling's Oxides; Oertlings show not only balances, but also hydrometers and other measuring instruments. In addition to the firms already mentioned there are some good exhibits by Collett and Co., mainly for use by brewers, Pierson, Morrell and Co., mainly disinfectants, and John Knight, soaps and toilet preparations, and British Cyanides Co., prussiates and permanganates. The various exhibitors do not

confine their operations to the groups broadly outlined above; many of these include chemicals belonging to several of the groups, but this article is not intended to catalogue the products made by different firms; its purpose is mainly to call attention to the fair as a symbol of the growing interest of the public in the achievements of modern applied chemistry. British Applied Chemistry is second to none. The co-ordination of applied chemistry and commerce, the union of financiers and chemists, the understanding of our problems by governments and government departments, these are the opportunities for an improvement in our conditions, and they provide also the lurking places of doubt and disaster.

THE CHEMISTRY OF INKS.

A series of three Cantor lectures on "Inks" was delivered by Mr. C. A. Mitchell before the Royal Society of Arts on January 23 and 30, and February 6. The following is a *résumé* of some of the points which are of especial interest to chemists.

Carbon Inks.—The last communication to the Society on the subject was made by Underwood in 1857. The presence of iron in old writing in carbon inks does not, as Underwood suggested, prove that a mixture of carbon and iron-gall inks was used, but is probably due to impurities in the carbon. This inference receives support from the recent work of Lucas on the carbon inks of Egypt (*Analyst*, 1922, 47, 9—15). Chen-ki-Souen's pictures (about B.C. 2697) show that the early methods of making Chinese carbon inks were substantially the same as those now used. Methods of fractionating the lampblack were known at a very early date, and different grades were used in different qualities of ink. Modern Chinese and other carbon inks may be tested by determining the comparative rates of subsidence of equal quantities of the material suspended in water. The best modern Egyptian inks will retain carbon in suspension for several years (Lucas, *loc. cit.*). Sepia, which was once used as a writing ink, is now chiefly employed as a pigment. The presence of lampblack may be detected by the behaviour of the separated carbonaceous pigment towards bleaching agents, and by the fact that the genuine insoluble pigment contains a high proportion of nitrogen (e.g., 8.4 per cent.).

Iron-gall Inks.—The change from carbon to iron-gall inks dates back to about the 9th century B.C. in this country, but in Egypt they appear to have been used at a still earlier period (Lucas). The variations in the preparations of galls and coppers recommended in early household recipes and in published researches of the 18th century are to be attributed to differences in the proportion of tannin in the galls used.

Modern iron-gall inks differ from those of the early type in the fact that they are not allowed to undergo any material oxidation before bottling and require a provisional colouring matter (indigo or "soluble blue") to give colour to the writing pending the formation of the iron tannate on the paper.

The so-called "acid-free" inks are prepared from gallic acid. They have the advantage of not corroding steel pens, but are deficient in penetrating power and do not contain sufficient iron to be used as inks for record purposes. Such inks should be made from coppers as free from acid as possible, and the use of ferrous ammonium sulphate appears to be suitable for the purpose.

Inks which darken rapidly have been made from ammonium oxy-ferrigallate, and Röhm's double

ferric salt, $\text{FeSO}_4 \cdot \text{Cl}_6 \cdot \text{H}_2\text{O}$, can be used for ink making. It has the advantages of not acting upon aniline dyes and of being remarkably stable.

The Stability of Inks.—To form an "ink," i.e., a solution yielding with iron salts a permanent stain on paper, it is necessary that a compound should contain three hydroxyl groups in juxtaposition, and the same rule also applies to the inks formed with vanadium salts and with osmium tetroxide. Osmium pyrogallate yields an ink which blackens immediately and is very permanent.

The objection to the use of neutral chrome logwood inks is that no method of rendering them stable has been discovered, whilst vanadate inks turn yellow on the paper.

In examining inks the main requirements to be considered are permanency of the writing and stability in the bottle or ink pot. The British Government has now made specifications for inks, in which a minimum of 0.2 per cent. of iron is required for a fountain-pen ink, and 0.5 per cent. for a standard ink for record purposes.

The stability largely depends upon the proportion of acid used, and hitherto no official specification for this factor has been published. During the last three years ink manufacturers have had numerous complaints of the ink changing colour and forming deposits in the bottle, and this has been traced to alkalinity derived from the glass of the bottle.

Ink, in oxidising, undergoes a change from a soluble tannate, first into a colloidal compound and then into an insoluble tannate containing 5.5 per cent. of iron (Wittstein), and, finally, there is an oxidation into a tannate containing 8.0 per cent. of iron (Pelouze), which is insoluble in very dilute acids. Copying tests of age are applicable until the complete formation of Wittstein's tannate, and tests with dilute acids until Pelouze's tannate has been completely formed. When that final oxidation occurs the particles of any blue dye present are prevented from dissolving by mechanical means.

In examining ink on charred paper it is advisable to treat the fragments with a solution of aluminium acetate and to ignite them so as to leave a coherent ash on which the residual iron from the ink can be made visible by means of ferrocyanide or thiocyanate.

Copying Inks.—The methods of preparing iron-gall-copying inks depend on the presence of a soluble tannate in the ink in writing freshly applied to the paper. All iron-gall and logwood inks are copying inks, but, in practice, increased amounts of pigments are used, with gum or glycerin to retard the oxidising process.

Marking Inks.—The most recent development in the manufacture of marking inks is the extended use of aniline inks in one solution. The oxidation of the aniline salt is prevented while in the bottle, and only occurs after the ink has been applied to the fabric. Some of these inks contain free acetic acid, and others free aniline, which volatilise from the fabric, but the exact methods of preparation are preserved as trade secrets.

Printing, Typewriting and "Safety" Inks.—Tests for printing inks should preferably be made in conjunction with the practical printer. The lakes made from certain diazo dyes are more permanent in printing inks than any of the mineral pigments.

Inks for typewriters are intermediate between printing and writing inks. The coloured inks usually contain methyl violet or other aniline dye, sometimes in the form of a lake, with glycerin or other medium, which is sometimes a semi-drying oil. Carbon, in some form or other, has been used in many of the black inks for many years, but experiments have indicated that it would be an improvement in the case of record inks if this carbon were added in the colloidal form. The so-called "safety inks" frequently contain colloidal graphite, which

is more suitable for the purpose than ordinary lampblack.

Secret-Writing Inks.—Inks for secret writing became of importance during the war. The earlier German agents used lemon juice, but, later, various chemical preparations were employed. The subject was fully dealt with in German scientific literature long before the war, and the methods of developing secret writing with iodine vapour and with ink were described at length. The action of ink in developing saliva-writing is partly physical and partly chemical. Increased absorption of pigment takes place where the surface of the paper has been scratched, whilst apparently certain constituents of the saliva accelerate the oxidation of the ink, so that Pelouze's tannate is formed more rapidly in the presence of saliva than when the ink is exposed to the air under normal conditions.

SOCIETY OF CHEMICAL INDUSTRY.

GENERAL COUNCIL FOR CANADA.

The Council of this Society has approved the formation of a General Council for Canada for the purpose of dealing with questions that may arise with regard to Federal and Provincial Legislation, and the following representatives of the Canadian Sections constitute the membership:—Messrs. H. W. Matheson, C. R. Hazen (Montreal), F. J. Hambly, S. J. Cooke (Ottawa), M. L. Davies, E. G. Ardagh (Toronto), F. W. Skirrow, F. E. Dickie (Shawinigan Falls), and E. H. Archibald, J. A. Dawson (Canadian Pacific). Mr. T. H. Wardleworth, of Montreal, is the chairman, and Mr. Alfred Burton, of Toronto, the hon. sec. of the Council.

NEWS FROM THE SECTIONS.

MONTREAL.

The fourth ordinary meeting of the session, held on January 19 in the Queen's Hotel, was a joint meeting with the Montreal branches of the Canadian Institute of Mining and Metallurgy and the Engineering Institute of Canada. Over 100 members and guests were present, and the usual informal dinner was held before the meeting.

In a paper on "The Administration of the Explosives Act in Canada," Lt.-Col. G. Ogilvie, Chief Inspector of Explosives, Ottawa, outlined the conditions which prevailed before the passing of the Act in 1912, traced the development of the organisation for its enforcement, and explained various points in the regulations.

The Act regulates the manufacture, testing, storage, importation and transportation of explosives. There are no provisions applying directly to the user; his protection lies in the control exercised over the manufacture, etc. Most accidents are due to gross carelessness on the part of the user, but many have been traced to the negligence of principals of large undertakings concerning the manner in which their explosives are stored and used. The explosives used in Canada are largely of home manufacture. Blasting explosives, etc. are practically all made in the country, but fireworks are mainly imported. Exception has been taken to some classes of fireworks, the importation of which has been barred on account of their composition, e.g., crackers containing white phosphorus; and also because the violence of their explosion renders them unsafe in the hands of young boys. Mining Departments of certain Provincial Governments issue lists of "Permitted Explosives" which may be used in the underground workings of mines.

There are no stations in Canada for testing explosives for this purpose, but the provincial authorities are guided in their decisions by the reports of the tests carried out in Great Britain and by the Bureau of Mines in the United States on explosives of similar composition. There are 19 factories in Canada licensed to manufacture explosives, including one making fulminate of mercury, operating for a short period each year, and five, of which two are in continuous operation, manufacturing fireworks. The fact that the supply of explosives, exclusive of fireworks, is derived almost entirely from Canadian factories not only facilitates the authorisation of the explosives put on the market, but assists the authorities inasmuch as the manufacturers use their influence with their customers in regard to their safe storage.

A paper on "The Generation of Steam by Electricity" was read by Mr. F. T. Kaelin, chief engineer to the Shawinigan Water and Power Co.

Generators of small capacity have been in use for some years in Europe, especially in France and Italy; they are now being introduced into North America, and the installations are of greater capacity than those used in Europe. Two types of generators are used: those in which the heat is produced by metallic resistors, and those in which the resistance is that of the water itself. The generators described and illustrated in the paper were of the latter type. The manipulation of a properly installed system is as simple and safe as that of an ordinary system using coal or oil. The generation of steam by electricity is economical for plants buying electric energy in large blocks on a flat-rate basis if the peak load is used only a part of the time. The power which would otherwise not be utilised between peaks can be used for generating steam for heating and cooking operations, and the plant fitted to work in conjunction with the main boiler equipment. The equipment is inexpensive, requires very little space in proportion to its capacity, and is economical in labour and fuel. Practical experience has shown that the generator has an efficiency of 98 per cent. net, 1 kw.-hr. being equivalent to about 3.12 lb. of steam.

In the interesting discussion which followed Mr. Hambly stated that a generator had been installed in Buckingham with very satisfactory results.

YORKSHIRE.

The third meeting of the session was held in Leeds on February 20, with Mr. S. H. Davies in the chair. Mr. H. Waites read a short paper on "The Limits of the Agglutination Test for Ricin." The presence of ricin, a toxic substance related to albumin, in castorseed cake renders it unfit for cattle food, and during the war efforts were made to eliminate this poisonous constituent. In an investigation on the methods of testing for ricin, the author, using the agglutination test, and assuming the original cake contained 0.5 per cent. ricin, found that when the fresh blood of a guinea pig was diluted to 1 in 20 with dilute salt solution and mixed with the cake extract (obtained by treating the crushed seeds with a similar dilute salt solution), the addition of a measured quantity of extract containing 0.00004 gram of ricin just gave a perceptible agglutination of the blood corpuscles, and this was considered the limit of the test. The chairman, in conveying the thanks of the Society to Mr. Waites, said that they were also much indebted to the Hull Oil Manufacturing Co., Ltd., for allowing the publication, and he hoped many other firms in Yorkshire would follow its example and encourage their chemists to read papers before the Section.

A paper on "The Structure of Coke," by Prof. J. W. Cobb and Mr. H. D. Greenwood, was pre-

sented by the former. The effect of carbonising the same coal at various temperatures was examined by determining the specific gravity, porosity, and weight of the resulting samples of coke. Three temperatures were chosen, viz., 550°, 850°, and 1100° C., as representing, respectively, the approximate conditions of low-temperature, ordinary gas-works, and coke-oven practice. The original coal had sp. gr. 1.27; when carbonised at 550° C. the resulting coke had a porosity of 44.7 per cent., and the sp. gr. of the coke substance was 1.59. The total volume was 3 per cent. greater than that of the original coal; such swelling is the cause of much difficulty in low-temperature processes. At 850° C. a maximum porosity of 52.5 per cent. was obtained, and the sp. gr. of the coke substance increased to 1.87. The coke was much harder than the product obtained at 550° C. and the changes in the weight, porosity, etc. show that this hardening is accompanied by a thinning of the cell walls.

At 1100° C. a hard coke was obtained which had properties like those of a good commercial sample of metallurgical coke. The hardening in this case is accompanied by a thickening of the cell walls, and this circumstance is regarded as one main difference between gas coke and hard metallurgical coke. The hard coke had a porosity of 45 per cent., and the sp. gr. of the coke substance remained at 1.87, which, as was pointed out, is much lower than that of graphite (2.3). Mr. Greenwood then described the methods used in determining the specific gravity and the porosity of the samples.

BIRMINGHAM.

A meeting was held on February 23, when Dr. Brownson presided and Mr. W. J. Rees read a paper on "The Testing of Refractories."

The chief factors determining the life of refractories are the softening temperature, the mechanical strength at normal and high temperatures, the thermal or reversible expansion, the permanent expansion or contraction, and resistance to abrasion, slag attack and abrupt changes of temperature. Tests should be conducted under conditions that approximate closely to those of actual use and although tests on whole bricks are more useful than those on small portions, a test on a section of built-up brickwork is better still. Chemical analysis is usually performed first, but it is insufficient inasmuch as it takes no account of the texture, i.e., the homogeneity, extent of vitrification, porosity, and the size and shape of the grains of the material.

The mechanical resistance of a refractory to abrasion by hot dust-laden gases mainly depends on texture, whereas its chemical resistance is largely determined by its chemical composition. Tests for the softening or fusion temperature should be made on not less than three pieces. The Hirsch electric furnace is usually recommended for this purpose, but furnaces fired with coal gas are quite satisfactory. In using such a furnace whole bricks are supported on a convex refractory surface, the softening occurs at 50°–150° C. below the temperature obtained with small samples, and tests have shown a difference in this respect of 20° C. with silica bricks and 30°–40° C. with fireclay bricks heated to 1000° C. for 4 hours; at 1300° C. and after 8 hours' heating the differences were 10° C. and 15° C., respectively. The cold-crushing strength of firebricks varies with the texture and the extent of burning or degree of vitrification. The mechanical strength is much lower at high temperatures because a viscous condition gradually develops. Mellor has shown that the sensitivity of a fireclay brick to load increases with increasing alumina content of the clay, and decreases with decreasing silica content. At high

temperatures coarse-grained silica bricks show a smaller loss of mechanical strength than fireclay bricks because of the greater viscosity of silica; fine-grained silica bricks show a greater loss unless they have been so well burned that much of the silica recrystallises. Tests of resistance to load are preferably carried out on whole bricks. To test the probable change in volume of a brick in use at high temperatures, the temperature is slowly raised to and maintained at 1410° C. for 4 hours. Resistance to corrosion by slag, dust or ash may be roughly determined by placing the slag, etc. in a hole drilled in the material and heating under predetermined conditions; but it is better to place the slag in a clay-ring cemented on the face of the brick, as the lower porosity of the face may reduce the speed of corrosion. In answer to the chairman, the author said that he would recommend the load test as the best simple test for classifying a firebrick for a special purpose.

GLASGOW.

At the ninth meeting of this session, held on February 24, the chairman, Mr. J. H. Young, called upon Dr. Caven to move the adoption of the Rules of the Section as revised by the local publication committee, and these were confirmed. The secretary drew attention to the Fellowship offered to Glasgow by the British Industries Fair, and asked the meeting to nominate a candidate and to suggest subjects for research. The meeting decided to do so and to suggest to the Glasgow Chamber of Commerce—which will elect the Fellow—that the study of the petroleum and oil shales of Canada would be a suitable subject for investigation.

Mr. T. H. P. Heriot then read a paper entitled "The Crystallisation of Sugar."

The juice of the sugar-cane and sugar-beet, containing from 83 to 88 per cent. of water, is concentrated first in multiple-effect evaporators to syrup, and the syrup is subsequently boiled and crystallised in vacuum pans. In the vacuum pan operations there are four main stages: rapid concentration to produce supersaturation, formation of crystals called "graining," growth of the crystals, and final concentration of the mother liquors. The mother liquors are separated from the crystals in centrifugal machines, and the operation is known as "curing." In modern methods of crystallisation only one or two grades of sugar are obtained, the low grades being avoided by "mixed boilings." In the manufacture of "plantation white sugar," the mother liquors or "molasses" are removed as completely as possible by spraying the crystals with water while they are in the centrifugal baskets. To obtain a perfectly white sugar ultramarine is also added as a spray, or during crystallisation in the vacuum pan. "Plantation white" sugar is decolorised without the use of bone-char, which is only used in the refinery.

The methods of crystallisation in the refinery are the same as in the raw-sugar factory, but the size of the fully-grown crystals is determined by the variety of refined sugar to be made:—granulated, cube, castor, etc. The largest size of crystals made in the refinery is known as "crystal" or "coffee sugar" and measures about 8 mm. square. "Granulated" is a medium size. "Castor" is the smaller and broken crystals separated from "granulated" by sifting. "Ice sugar" is of the same origin but ground to a fine powder in mills.

Refined sugar is further recrystallised by the manufacturing confectioner in the production of "sugar candy" by the slow cooling of a hot saturated syrup, and there is no limit to the size of these crystals, which grow in clusters. The confec-

tioner also produces the smallest sugar crystal (0.005 mm. square) in the form of "fondant" used as the centres of chocolate-creams, and obtained by rapid cooling of a supersaturated solution, with vigorous agitation.

Mr. Heriot, in concluding, suggested that no supersaturated solution would crystallise unless solid particles, possibly ultra-microscopic, were present, and also that, by the use of gelatin, such particles might be detected by a "culture" method analogous to that used by the bacteriologist. In reply to questions, he explained that raffinose was only found in beet juice and caused the formation of needle-shaped crystals. The relative sweetness of different sugars cannot be determined by placing the crystals directly on the tongue because the same sugar then appears less sweet when in the form of large crystals than when crushed to a powder. The only reliable method is to taste dilute solutions, of known concentrations, of the sugars to be compared.

EDINBURGH AND EAST OF SCOTLAND.

The fifth ordinary meeting of the session was held on February 13 in the New Chemistry Laboratories of the University, King's Buildings, Edinburgh, Dr. H. E. Watt presiding. Prof. Sir James Walker gave a general description of the plan of the new buildings and then conducted a tour of the laboratories. In moving a vote of thanks to him the chairman referred to the splendid facilities provided for the teaching of chemistry in the university. The secretary announced that the Sectional committee proposed, subject to the approval of the Council, to admit Associates to the Section, and this was unanimously agreed to.

A joint dinner was held with the Local Section of the Institute of Chemistry on February 23 in Ferguson and Forrester's Restaurant, Edinburgh. Dr. A. Lauder, vice-chairman of the Local Section of the Institute, presided, and 39 members and guests were present. After the loyal toasts Mr. A. Maitland, of Messrs. J. and G. Cox, proposed the "Profession of Chemistry," which was replied to by Dr. T. W. Drinkwater on behalf of the academic chemists, and by Mr. W. A. Williams on behalf of industrial chemists. Mr. J. Rutherford Hill gave the toast of "The Ladies," which was acknowledged by Mrs. H. E. Watt, Dr. Dobbin that of "The Artists" who had taken part in the musical programme, and the toast of "The Chairman" was given by Dr. J. F. Tocher.

MEETINGS OF OTHER SOCIETIES.

THE PHYSICAL SOCIETY.

On February 24 a demonstration was given by Mr. F. C. Dyche-Teague of the physical properties of "Cellactite," which is prepared by dispersing hard pitch in a ball mill in about an equal volume of water, using from 0.1—0.25 per cent. of resin soap as dispersator. The resulting colloid is mixed with about an equal amount of asbestos or cellulose-fibre pulp, so that the pitch is coagulated upon the fibre, and the material is then fashioned into soft pliable sheets on a paper machine. After stripping from the machine, the sheets are compressed while subjected to suitable heat treatment. "Cellactite," the acid-proof material so produced, can be nailed, punched, screwed, etc. without splitting or cracking, and can be finished a red warm colour or in various shades of green. It is a good electrical insulator; the specific resistance of a sheet 5.5 mm. thick under a pressure of 500 volts is about

5.5×10^7 megohms per c.c. Corrugated sheets of the material possess great strength, and show no sagging when subjected to a surface temperature as high as 190° F. It smokes and smoulders when placed in a flame, but the combustion ceases when the flame is withdrawn. No sign of flaking or other deterioration was exhibited by a specimen exposed as roofing material to the atmosphere of Manchester for over two years. For roofing, a cellactite sheet $\frac{1}{4}$ " thick will cover a somewhat larger superficial area than an equal weight of No. 24 galvanised iron. The material is supplied by Messrs. Cellactite (Founders), Ltd., 5, Victoria Street, Westminster, S.W. 1.

The following new apparatus was demonstrated by the research staff of the General Electric Co., London:—(a) Rapid-weighing Balance, designed primarily for weighing extremely small masses, of the order of a few mg. The balance consists of a horizontal torsion fibre, to which is attached a horizontal lever. Torsion is given to the fibre by suspending the mass whose weight is required from a point on the lever, and the motion of the lever is magnified by means of a series of very fine wires, the last wire of the series hanging under its own weight. An image of this last wire is projected upon a graduated scale, the optical system employed magnifying the motion of the wire. The balance takes a load up to 40 mg., and the scale indicates variations of 0.1 mg. It has found useful application in the rapid determination of the variation of the weights of large numbers of samples of fine-drawn wires, e.g., those employed in electric-lamp manufacture, from an assigned standard.

(b) Apparatus for the Measurement of the Density of Fine Wires. A fine wire, such as that referred to above, is clamped horizontally at one end, within an exhausted chamber. By means of a reading-microscope, the depression of the free end of the wire below the level of the clamped end is ascertained. This is best done by halving the difference of readings obtained by inverting the containing chamber. When the latter is filled with liquid of known density, the depression of the free end is diminished on account of the upward thrust due to the liquid, experienced by the fine wire. From the depressions observed in the two cases, the density of the material of the wire is readily ascertained. The method is applicable to the determination of the density of a wire whose weight is of the order of 1 mg.

(c) An Electrostatic Voltmeter. This is of the attracted-disc voltmeter type, and the motion of one disc, when charged, is magnified by use of the lever system employed in the rapid-weighing balance described above. The instrument is heavily damped, its range is varied by adjusting the distance between the plates, and the scale of volts is nearly uniform.

INSTITUTION OF AUTOMOBILE ENGINEERS.

In the paper on "The Physical Properties of Motor Fuels," presented to the Glasgow and Birmingham sections of this Institution on February 20 and 21, Dr. W. R. Ormandy and Mr. E. C. Craven reviewed the known physical properties of volatile fuels in relation to their behaviour in internal-combustion engines.

The heat of combustion is taken first as being the most important factor in determining the amount of energy developed in the engine. For unit volume of the theoretical mixture of the vapour of any fuel with air the heat of combustion is practically a constant, so that other factors, such as the intrinsic change in volume on combustion, have to be considered in this relation also. The authors then pass to the effect of low temperatures. If

benzene be present separation of a solid phase is liable to occur. In mixtures containing alcohol separation into liquid phases may occur under conditions which are discussed in some detail. It is shown that if it be desired to add a small proportion of ethyl alcohol to petrols in order to decrease their liability to "knock," the alcohol must be nearly anhydrous.

In considering the distillation-range of petrols, the important temperatures are those at which (1) the initial fractions distil, (2) 50 per cent. distils over, (3) the distillation ends ("dry point"). Ease of starting is governed by the easily volatile fractions, general performance by the mid-distillation point, whilst heavy fractions are undesirable from several points of view. Dealing shortly with the latent heat of evaporation of fuels, it is pointed out that it is a mistake to attempt to supply to the inlet-air sufficient heat to vaporize the fuel. Such attempts merely lead to low volumetric efficiency. Flash-points and explosive range are considered in the light of the authors' recent work on these properties and some interesting relations are mentioned. The explosive ranges of all the hydrocarbon fuels are very much of the same order, but higher figures are obtained with the alcohols. Interesting points are also mentioned concerning the corrosiveness of fuels containing alcohol, which is one of the outstanding difficulties connected with the use of this fuel. Viscosity is also considered briefly. The last two sections of the paper deal with the important properties toluene-number and spontaneous-ignition temperature, between which there is, in all probability, a real relationship, and an indication of this is given.

The authors admit freely that very much more work is necessary before the behaviour of a fuel in an engine can be predicted from its physical characteristics. The list of properties considered is, of course, not complete, but in a general way the great theoretical and practical interest of such properties is indicated.

THE ROYAL INSTITUTION.

On February 16 and 23 Prof. A. G. Perkin delivered lectures on "Dyeing: Ancient and Modern." In the first lecture, he reviewed the evolution of the art from the earliest times. The practice of dyeing originated in the East and it is most probable that Indigo was the first dye to be discovered. Among the few natural direct dyes are Safflower and Annatto: these are utilised in alkaline solution and the real colour developed by a subsequent acid bath. Safflower Red and Yellow were used by the Egyptians 2500 B.C. for dyeing mummy cloths. Other natural products gradually came into use owing to the discovery, 2500 B.C. approximately, of previously mordanting the various fibres with metallic oxides. These methods are still in use to-day. Dyeing with Madder, Lac Dye, Persian Berries, was carried out by this process from very early times. The first of these and its analogues probably occupied the most important positions and were used by the ancients for the famous Turkey Red. In this case the cotton required many tedious oil-mordanting treatments—a remarkable discovery, the whole operation lasting some months. The examination of Madder led to the discovery of Alizarin and of its subsequent commercial synthesis; this has led to the disuse of the natural product. Again by the aid of Alizarin and the intermediate products of its manufacture, there have now been prepared numerous fast dyestuffs, which are of the greatest importance.

In several cases, the natural colouring matters are not contained in the plant in the free state but as glucosides, e.g., fresh Madder and Persian Berries. During the dyeing operation, an enzyme present

hydrolyses the glucoside with the formation of the colouring matter which then enters into combination with the mordant on the fibre.

The use of Indigo, which was next in importance to Madder, dates back to before 3500 B.C. The vat-dyeing method devised by the ancients is in use at the present day. A dye held at one time in great esteem was the Purple of the Ancients, also called Tyrian Purple. This was obtained from sea snails or molluscs, and materials were dyed by steeping them in an infusion obtained therefrom and subsequent exposure to air. This dyestuff has been shown by Friedländer to be a dibromindigotin.

In the second lecture an account was given of the gradual replacement of the natural mordant dyes. The introduction of the bright but fugitive basic colours at first produced, was without great effect, though the production of artificial Alizarin and other fast mordant dyes derived therefrom, more seriously affected them. The main blow to the natural dyes was, however, the discovery of the acid mordant and the acid alizarin colours, many of which are not only fast, but can be applied by a one-bath method. Logwood, Fustic, Persian Berries, Catechu and natural Indigo, are, however, still in use.

The most important recent advance has been the production of vat colours, of almost every desired colour, many of which are much faster than Indigo itself. These are mainly used in cotton-dyeing, where great durability is required, and are applied in a similar manner to Indigo itself.

After reviewing the Sulphide dyes, which are also of the vat class, colouring matters developed *in situ* on the fibre, e.g., Aniline Black, Nitroso Blue, the mineral dyes, and the insoluble azo colours of the paranitraniline-type, were discussed, brief allusion being made to the large groups of the acid azo and salt dyestuffs. Aniline Black and the Sulphide Blacks have replaced Logwood Black in cotton-dyeing, whereas Paranitraniline Red, more especially that obtained with β -hydroxynaphthoic anilide and the nitranilide, have been competing to some extent with Turkey Red.

The lectures, which were illustrated by numerous experiments and samples of dyed material, concluded with a brief reference to the effect of reagents on the textile fibres and the alteration thereby of their dyeing properties, special reference being made to mercerised cotton, chlorinated wool, and acetyl silk.

THE CHEMICAL SOCIETY.

At the meeting held on February 16, presided over by Sir James Walker, the following papers were read:—"A Theoretical Derivation of the Principal of Induced Alternate Polarities": A. Lapworth; "An Explanation of the Property of Induced Polarity of Atoms and an Interpretation of the Theory of Partial Valencies on an Electronic Basis": W. O. Kermack and R. Robinson; "Some Reactions of Benzantrone": A. G. Perkin and G. D. Spencer; and "A Rapid Iodimetric Estimation of Copper and Iron in Mixtures of their Salts": I. W. Wark.

The papers of Prof. Lapworth and Prof. Robinson, dealing generally with independent conclusions arrived at from the same subject matter, were taken together for purposes of discussion. Each author applies the Lewis-Langmuir theory to organic chemistry. Partial valency is interpreted on the basis of the electron and electron-sharing between the atoms constituting a molecule. Explanations are thus afforded of alternate polarity and induced polarity by the addition of other atoms or groups. Prof. Lapworth has modified his original ideas, acting on a suggestion of Prof. J. B. Cohen, by

making one partial bond equal to one electron and therefore one ordinary bond of organic grouping equivalent to two partial bonds or two electrons, instead of dividing one ordinary bond into three partial bonds. It has still to be decided whether the introduction of the electronic concept will simplify organic chemistry or merely complicate it. Profs. W. H. Perkin, Thorpe and Desch adopted a non-committal attitude, but Dr. Sidgwick opposed it.

The method of Mr. I. W. Wark for the estimation of copper and iron in mixtures consisted of a double titration with iodine with successive additions of phosphate and mineral acid. The method was stated to be rapid and fairly accurate, but inapplicable if either the copper or the iron were present in small amount.

The meeting held on March 2 was devoted to the reading and discussion of three papers on organic chemistry, viz., "New Halogen Derivatives of Camphor. Part II. α -bromocamphor": T. M. Lowry, V. Steele, and H. Burgess; "The Rotatory Dispersive Power of Organic Compounds. Part X. The Preparation and Properties of Pure Ethyl Tartrate": T. M. Lowry and J. O. Cutter; and "The Molecular Configuration of Polynuclear Aromatic Compounds. Part I. The resolution of γ -6:6'-dinitro- and 4:6:4':6'-tetranitro-diphenic acids into optically active components": G. H. Christie and J. Kenner.

The chairman, Dr. M. O. Forster, announced that there would be no election to fill the vacancies on the Council at the forthcoming annual meeting, as the number of nominations received was equal to the number of vacancies.

THE INSTITUTE OF CHEMISTRY.

At the forty-fourth annual meeting, held on March 1, the president, Mr. A. Chaston Chapman, presented the first Meldola Medal to Dr. C. K. Ingold. The medal, which is the gift of the Society of Maccabaeans, has been instituted as a memorial to Prof. R. Meldola, and is awarded for original work in chemistry conducted by British subjects under 30 years of age.

In his presidential address Mr. Chaston Chapman said that the work of the Institute had greatly developed with the increasing recognition of the national importance of chemistry. During the past year the membership had risen by 371 to over 3540, and the number of students by 84 to 883. The older members had the satisfaction of seeing the Institute acknowledged alike by chemists, the public, and the Government, as the body truly representing professional chemistry in this country. Every member should help to consolidate the position they had gained and to keep the public mind alive to the enormous national importance of the profession. Probably no single factor had so greatly retarded the progress of chemistry in this country as the misapplication of the word "chemist." In no other country was there any confusion between those who practised chemistry and those who practised pharmacy, and it was to be hoped that whenever possible the pharmacists would refer to their ancient and honourable profession by the word which more accurately defined and described it; he appealed to the Press to assist by employing the terms "chemist" and "pharmacist" in their correct significations. If chemists themselves used the word without qualifying adjectives, it would be an effective step towards establishing the proper meaning of the word.

The Council of the Institute, and many others who wished to see the production of laboratory glassware, porcelain, and fine chemicals firmly established in this country, held that it would be a

fatal mistake again to become dependent for their supply on foreign—and possibly enemy—nations. All branches of chemical industry, scientific research, and the practical teaching of science depended upon a supply of these products that was adequate in quantity, suitable in quality, and reasonable in price; and the establishment of these essentially chemical industries demanded the services of properly qualified chemists. Great progress had been made under difficulties, and there appeared to be no good reason why we should not be self-supporting in all the requirements of the profession.

After complimenting the Local Sections on their activity and acknowledging the help they had given the Council, Mr. Chaston Chapman commented upon the fact that, at a time of almost unparalleled industrial depression, less than 2 per cent. of the members was without employment, and said it might be inferred that employers were looking more and more to science for help in overcoming technical difficulties and in improving manufacturing operations. Many parents believed that chemistry afforded a rapid road, if not to wealth, at least to a comfortable competence, and that it involved a comparatively inexpensive course of preparation. Actually the training involved much hard, and often unattractive, work, and made the same demands upon the financial resources of parents as that for medicine or law. The present position of the profession should inspire its members with feelings of pride and stimulate them in the endeavour to raise it higher still. There was scarcely a department of human activity that was not influenced more or less profoundly by the discoveries and developments of chemistry, and it was not unlikely that if any distinctive term should be applied by the historian to the present era, he would describe it as the "Age of Chemistry."

The following new officers were elected for the ensuing year:—Vice-presidents: Messrs. A. Moro and W. Rintoul. Members of Council: Dr. E. F. Armstrong, E. R. Bolton, Dr. A. A. Boon, R. L. Collett, F. A. Frooth, G. N. Huntly, G. H. Perry, Dr. J. C. Philip, Sir T. K. Rose, C. J. H. Stock, Dr. G. Tate, Dr. D. F. Twiss, and Dr. F. J. Wilson; and in addition 12 District Members of Council. Prof. G. T. Morgan was elected a censor.

SOCIETY OF PUBLIC ANALYSTS.

Four papers were read at the meeting held on March 1 in the Chemical Society's Rooms, Mr. P. A. Ellis Richards presiding.

(1) In a paper on "The Theobromine Content of Cacao Beans and Cocoa" Mr. R. V. Wadsworth showed that the theobromine content of nibs from 21 different producing areas varied from 2.2 to 3.9 per cent., calculated on dry, fat-free material. This variation, he found, depended on the variety of bean and on the degree of fermentation, a process which considerably reduces the theobromine content. In the shell the theobromine content varied much more (0.19–2.89%) than in the nut, the alkaloid being carried by the sweatings from nut to shell. No theobromine was lost from nibs or shells during roasting. In 22 brands of commercial cocoa the theobromine content was found to vary from 2.39 to 3.55 per cent., calculated on dry, fat-free cocoa.

(2) "The Value of Fish Scales as a Means of Identification of the Fish used in Manufactured Products."—Mr. R. E. Essery pointed out that useful information on the variety of fish employed in manufacture could be obtained from a microscopical study of the scales. Even when the scales were largely broken up, as in fish-pastes, the method was of value.

(3) A contribution on "The Examination of B.P. Ointments" was read by Messrs. N. Evers and G. D. E. Elsdon, in which analytical methods were described for examining certain B.P. ointments, and the value of the refractive index as a method of testing was discussed.

(4) A paper on "The Determination of Aldehydes and Ketones by means of Hydroxylamine" was read by Messrs. A. H. Bennett and F. K. Donovan, the former of whom had previously described a method for estimating citral in lemon oil (*cf. J.*, 1909, 159). This method is now shown to be applicable to such aldehydes as formaldehyde, benzaldehyde, cinnamic aldehydes, and citronellal, and to ketones such as acetone and carvone, but not to camphor. Accurate results can be obtained with acetone even in presence of ethyl alcohol. The authors consider that the estimation of citral by means of hydroxylamine is preferable to the method involving absorption with sodium sulphate.

SOCIETY OF GLASS TECHNOLOGY.

The fiftieth meeting of the Society was held in the College of Technology, Manchester, on February 15. Dr. M. W. Travers, who presided, said that since its inception at the end of 1916 the Society had steadily increased its activities and membership. The number of members now exceeded 650, drawn from various parts of the world, and about one hundred were American.

Mr. F. W. Hodkin and Prof. W. E. S. Turner presented a paper entitled "The Relative Advantage and Disadvantage of Limestone, Burnt Lime and Slaked Lime as Constituents of Common Glass Batches containing Soda-ash and Salteake, Pt. II.," in which it was shown that the rate of melting depended on a number of factors, such as the form of alkali and lime used and the relative amounts of lime and soda employed. For glass such as that used for bottles made by automatic machines, and containing about 8 per cent. of lime, the soda-ash burnt-lime batch appeared to be the most readily melted. With lime-containing glasses the melting could be assisted considerably by the addition of small amounts of other oxides, particularly magnesia; when 21 per cent. of lime was present the batches containing slaked lime generally melted most readily.

The remainder of the meeting was devoted to a discussion on "The Melting of Glass" based upon questions previously submitted by members.

SOCIETY OF DYERS AND COLOURISTS.

The Manchester Section held a meeting on February 17, at which Prof. E. Knecht presided and Dr. S. Judd Lewis read a paper on "The Quantitative Fluorescence of Cellulose, its Derivatives, and Certain Other Substances."

When an ultra-violet spectrum of wave-lengths 3300 to 2100 (invisible to the naked eye) is projected on to a sheet of note-paper or a piece of bleached cotton fabric, the spectrum becomes "degraded," i.e., the ultra-violet rays are converted into visible rays which can be photographed with an ordinary camera. Various papers and fabrics examined under these conditions give photographic images of varying intensities according to their composition and mode of manufacture. Acetylation of the cellulose greatly increases the fluorescence, but nitration depresses it almost to vanishing point. The treatment to which cotton fabrics are submitted in bleaching, as well as the degree of beating of pulp in paper-manufacture, all find expression in the photographic images, so that it is probable that the method will be applied to the examination of other industrial products.

PROPOSED INSTITUTION OF CHEMICAL ENGINEERS.

At the meeting of the provisional committee, held on March 1, the hon. treasurer reported that the proposed institution had a credit balance of £400 19s. at the bank, £493 1s. having been expended out of the sum of £1232 promised. A draft of the memorandum, articles of association and by-laws was submitted for consideration before dispatch to the advisory committee for further discussion. Approximately 100 gentlemen have offered to serve on the advisory committee and offers are still coming in. After considerable discussion it was decided to accept the offer of Mr. W. J. U. Woolcock to provide temporary accommodation at 166, Piccadilly, London, W., the address to which all communications should now be directed. The committee will meet again on March 8 at 3 p.m. at the above address.

NEWS AND NOTES.

FRANCE.

Industrial Notes.—Fuel.—The consumption of petroleum in France has increased from 521,214 metric tons per annum before the war to 774,245 t. in 1921. In September, 1921, the consumption of motor spirit was 52,131 t., a figure never reached during the war, even at the time of the great offensive in 1918. "Mazout" is also being used extensively, especially for marine transport, as is shown by Lloyd's Register of Shipping, which records a much higher tonnage of ships using "mazout" during the year ended June, 1921, than of those using coal. One French firm alone imported 60,000 t. of this fuel. Although the use of petroleum and its products is thus steadily increasing, misgivings are being felt because the French output amounts to only 70,000 t. per annum, made up of 15,000 t. from the distillation of bituminous schists, 50,000 t. from Alsace (Péchelbroun), and 5000 t. from Algeria. As France must therefore import over 90 per cent. of the petroleum required, it is of the first importance to secure the necessary tonnage at the producing centres abroad and to improve the present inadequate arrangements for transport and storage.

The Société de Chimie Industrielle is organising an international congress for liquid fuels under the patronage of the Ministers of Commerce, Public Works, Agriculture, and of the Under-Secretary for Aeronautics. Prof. Paul Sabatier will preside over the congress, which will comprise five sections, viz., Petroleum, Schists, Lignite and Peat, Tar and Benzol, and Alcohol. At the same time an exhibition will be held to illustrate the various applications of liquid fuels.

Faced with severe English competition, the French coal industry is contemplating a reduction in miners' wages in order to lower prices by 6 to 8 francs per ton. Modifications in the law prescribing the 8-hour day are being discussed, and in consequence of pressure brought to bear by the Ministry of Public Works, the chief public services have decided to use only French coal, unless its delivery price is more than 10 fr. higher than that of foreign coal of equal quality. Now that special railway rates have been sanctioned for metallurgical products, it is hoped that the rates for coal will also be reduced. If the adoption of these measures fails to provide a remedy, a further reduction in wages will be necessary. The Société Générale d'Entreprises, an important engineering undertaking, is studying the possibility of draining the mines of the

Brief coalfield partly by gravity through a central gallery and partly by pumping, and of utilising the water for industrial and agricultural purposes. Expert opinion regards the scheme as practicable.

Chemical Industry.—There is a good demand for heavy chemicals, but otherwise the market is dull. The fine-chemical industry is suffering from German competition and in some cases manufacturers have had to become merchants pure and simple. It is beginning to be realised in certain quarters that it does not pay to sell inferior products at high prices. During 1921 the value of the exports of chemicals was 857,223,000 fr. (about £16,485,158 with £1=52 fr.), compared with 1,133,619,000 fr. (£21,800,365) in 1920, and 211,396,000 fr. (£8,455,840 with £1=25 fr.) in 1913.

Metallurgy.—The negotiations for the resuscitation of the Comptoir Siderurgique are approaching completion. Much care and tact are required in adjusting the claims of the 35 constituent firms, and progress is necessarily slow. Owing to the difficulties attending these negotiations and the uncertain political situation, the market is very dull; were not a few important orders still in hand, the factories would be obliged to sell at any price in order to keep going. The orders for new rolling stock required by the railways in 1922 have been reduced to a minimum.

Protection Against "Mustard Gas."—The following methods are recommended by MM. A. Desgrez, H. Guillemand, and A. Labat for protection against dichlorodiethyl sulphide:—When small amounts of dichlorodiethyl sulphide are present on floors or walls of buildings, chloride of lime is the most effective counteractant; but for large quantities sawdust and soil should be scattered about to absorb as much as possible before the chloride of lime is applied. Water can be freed from mustard gas either by boiling, or by adding 6–7 c.c. of Eau de Javel (containing 50–60 gm. of available chlorine) to each litre together with a crystal of sodium hyposulphite after 10 minutes have elapsed; such water, however, is unfit for drinking. Cloth can be cleansed by steeping in water at 90° C. for an hour or by steaming in an autoclave at 120° C. for 20 minutes. Linen, however, requires to be steeped for 20 minutes in water at 50–60° C. containing 10 gm. dry sodium carbonate and 10 gm. black soap per litre, then boiled in clean water for an hour, and rinsed in cold water. Mustard gas is readily absorbed by leather and can only be removed by using an organic solvent, e.g., benzene, after which the leather has to be re-greased. The skin can be protected partially or entirely by vaseline ointment containing 10 per cent. of finely-powdered chloride of lime. To cleanse metallic objects dry chloride of lime, or better, thick lime wash can be used. Delicate metallic objects should be washed for 1–2 minutes either with warm water or with a freshly-prepared solution containing potassium permanganate (10 gm.), pure acetone (90 c.c.), acetic acid (10 c.c.), and then rinsed in water.—(*Chim et Ind.*, Dec., 1921.)

SOUTH AFRICA.

Industrial Progress.—The report of the General Manager of Harbours and Railways for 1920–21 refers to the great progress made by many industries during the war, owing to absence of foreign competition, and points out that although the present depression has temporarily arrested expansion, development is still proceeding in certain directions. Much, however, remains to be done, and industry can progress only by the rational utilisation of the unlimited resources in raw materials, assisted by cheap labour and an abundant coal supply. The number of factories is now 6869 and the gross annual output is valued at

£92,914,000, compared with 3998 factories with an output worth £40,435,000 in 1915–16. The value of South African materials utilised rose from £10,025,000 in 1915–16 to £23,554,000 in 1920–21.

Despite the economic situation, owing to which the production of pig iron from local ore fell by 454 tons to 1508 tons, several iron and steel works are being erected or extended. Shipments of wattle bark and bark extract rose to 78,911 t. bark and 9498 t. extract in 1920; since then trade has declined, but prices have fallen and there are signs of revival. Wattle extract is now being produced by a pneumatic process in a new factory at Pietermaritzburg, which has been established in conjunction with a new tanning-plant with a capacity of 16,800 tanned hides per month. Foreign competition has been greatly felt by the leather industry. Products of the coal industry in 1920 were valued as follows:—Coke £49,000; ammonium sulphate £63,000; tar 25,167 gallons (£3382). Over 200 tons of "duff" coal was shipped to England for testing; this coal has been regarded hitherto as of little value, but if the results are satisfactory it will be utilised in the manufacture of by-products. Recently-established factories include several glass-works in Natal, a large rubber factory in Howick, and a carbide factory is being erected at Ballengeich, Natal.

In the mineral industry progress is recorded in the extraction and export of mica in the Malelane district. Consignments of gypsum from Riverton and Windsorton stations increased to 8194 t.; and as the result of development work it is anticipated that the monthly output of 500 t. from the Klein Sabie pyrites mine will shortly be increased. Production of various other minerals was as follows:—Salt (sales) 64,939 t.; corundum £1446; fluorspar £4000; slate £4417; verdite £433; mineral colours £1049. Developments are in progress at the kieselsuhr mines at Sheepmoor, where a monthly output of 200–300 t. is expected, and in the mining of corundum at Bandolier Kop.

CANADA.

The Alberta Tar-Sands.—The C. E. Dutcher Oil Extraction Company has entered into an agreement with the Alberta Exploration Company to commence by July next the commercial extraction of crude oil from the tar-sands occurring along the banks of the Athabasca river. The former company has taken a 21-year lease of the Exploration Co.'s extensive holdings in the vicinity of Fort McMurray; it has been conducting experiments for some time, and the results are said to have been entirely satisfactory.—(*Can. Chem & Met.*, Feb., 1922.)

Mineral and Metallurgical Production in 1921.—According to the Bureau of Statistics, the production and value of minerals and metals in the Dominion was as follows:—Gold, 875,088 oz. (£18,089,674); lead, 31,633 short tons (£3,637,208); zinc, 26,583·5 t. (\$3,477,122); copper, 27,344·5 t.; nickel, 10,312·14 t. (\$8,455,954); silver, 13,058,710 oz. (\$8,208,703); asbestos, 75,000 t. (\$5,525,000); coal, 16,631,754 t. (\$80,693,723); gypsum, 429,144 t. (\$1,893,991); salt, 209,855 t. (\$1,544,724); pig iron, 695,000 t.; steel ingots and castings, 775,000 t. (*cf.* J., 1922, 33 n).

British Columbia produced minerals and metals to the value of \$23,934,848, or 18 per cent. less than in 1920. The separate items were as follows (figures in brackets are those for 1920):—Gold, \$3,155,140 (\$2,702,992); silver, \$1,611,152 (\$3,235,980); copper, \$4,127,312 (\$7,832,899); lead, \$1,754,400 (\$2,816,115); zinc, \$1,723,500 (\$3,007,979); coal, \$11,432,644 (65 per cent. of 1920 output); building material, \$1,775,460 (\$2,176,160).

The estimated mineral and metallurgical production of Nova Scotia for the year 1921 is as

follows:—Coal, 6,100,000 t.; pig iron, 158,600 t.; steel ingots, 203,600 t.; coke, 231,000 t.; limestone and dolomite, 73,000 t.; gypsum, 199,000 t.; gold, 350 oz.; manganese ore, 400 t.; barytes, 300 t.; salt, 2600 t.; ammonium sulphate, 4300 t.; benzol, 389,500 gallons; toluol, 29,000 galls.; solvent salt, 2600 t.; ammonium sulphate, 4300 t.; benzol, naphtha, 12,000 galls.; tar, 3,600,000 galls.; infusorial earth 300 t. (t.=2000 lb., gallon=imperial). All show a decrease compared with 1920, except gypsum.

AUSTRALIA.

Petroleum Exploration in Papua.—The Prime Minister has informed the House of Representatives that prospecting for petroleum is being continued in Papua, but not on the site originally selected. A party of geologists has been sent to explore in New Guinea (late German New Guinea). Staff work has been interrupted by malaria, but as the Government wishes to retain control of any oil discovered, the decision not to allow private persons to prospect is to be adhered to. Subject to Parliamentary ratification, it has been decided to buy out the British Government's interest for £25,000, and to carry out the operations solely for Australia. The Anglo-Persian Oil Co. has offered to share the expenditure (*cf. J.*, 1922, 9 R).—(*Ind. Austral.*, Nov. 24, Dec. 1, 1921.)

UNITED STATES

Evaluation of Glue and Gelatin.—Dr. R. H. Bogue, of the Mellon Institute of Industrial Research, speaking at a recent meeting of the American Chemical Society, emphasised the need of a better and more logical system for determining the value of gelatin and glue. Present methods of grading do not always utilise the real properties which determine value; there are too many systems in use for designating quality, nearly every firm using somewhat different methods; and as there is no standard of quality there can be no standard of price, a circumstance which favours the manufacturer and confuses the consumer.

Dr. Bogue proposes that a competent committee of chemists should select one, or a combination of, specifications as a standard, and he recommends as a primary evaluation the adoption of the viscosity test by the MacMichael viscosimeter, as it is very reliable, easily made, and its results are directly proportional to the melting point, gelatin content, adhesive strength, and jelly strength. The viscosity of a 20 per cent. solution at 32° C. should be taken as a standard for testing, and the result expressed in centipoises divided by 10 with the letter H or B prefixed to show the origin of the material. Thus H₁₁ would designate a product obtained from hido material having a viscosity between 130 and 139 centipoises, and B₁₆ a product from bone having a viscosity between 160 and 169 centipoises.

Secondary tests may be used for determining foam, grease, reaction, etc., and there should also be a test for hydrogen-ion concentration, as the properties of the products vary with this factor.—(*Chem. and Met. Eng.*, Jan. 18, 1922.)

Phthalic Anhydride from Naphthalene and Air.—A new method for the manufacture of phthalic anhydride by which naphthalene is oxidised directly by the air is described in the *Journal of Industrial and Engineering Chemistry*. With the aid of vanadium pentoxide as catalyst, naphthalene vapour is made to react with atmospheric oxygen. Former methods have employed nitric or chromic acids as oxidisers, and that in use in Germany before the war used sulphuric acid in the presence of a mercury salt. The latter process resulted in the discovery of the contact process for sulphuric-acid manufacture, which was worked out to get rid of

the large amounts of sulphur dioxide evolved by the reduction of the sulphuric acid.

Naval Stores from Dead Pine Trees.—Naval stores have been made since 1909 from the dead wood of southern pines, and the processes have now become so perfected that the products, wood turpentine, pine oil and wood rosin, are equal in quality to the similar products obtained from the sap of the living trees, says C. M. Sherwood, Naval Stores Division, Hercules Powder Co., in *Chemical and Metallurgical Engineering*. Wood turpentine is extracted from the crushed wood by distillation with live steam. Pine oil, which is obtained only from the dead wood, is distilled with the turpentine and separated by fractionating; it is used chiefly in paint and varnish, to give a "flat" finish, and as a frothing oil in flotation work. Wood rosin is extracted from the chips remaining after steam-distillation, gasoline being used as the solvent. The rosin thus obtained is a dark ruby red, a colour which appears to be due to the charring of the dead trees by forest fires.

BRITISH INDIA.

Industrial Notes.—*Manufacture of Glue in Madras.*—As a result of the experiments on the manufacture of glue which were carried out under the aegis of the Director of Industries, Madras, arrangements have been made for the transfer of a small experimental factory to the firm of Messrs. Beardsell and Co., who are to start manufacture on a commercial scale.

The Coir Industry.—With reference to the efforts being made to develop the coir industry in districts other than the West Coast, it is agreed that the first problem to be solved must be the chemical one, and that steps should be taken to ascertain exactly what bacteriological processes take place in the Malabar back-waters, where the coconut husks are retted, and particularly to determine to what extent the bacteria which accelerate the disintegration of the fibre from its surrounding tissues are inherent in the husk of the coconut itself and to what extent present in the water. Investigations are to be conducted in Malabar with the object of finding a process by which the bacteria might be artificially cultivated and utilised elsewhere.

Pottery in the United Provinces.—The Industrial Chemist has been investigating the possibility of improving local potteries, which are considerably handicapped by the lack of kaolin deposits. The glazing at present is not satisfactory, and as a result the potteries are now confining their attention to the production of decorative articles. Chunar glazing, for instance, cannot withstand alkalis, and Khurja glazing is merely a superficial coating which leaves the earthenware sufficiently porous to absorb moisture. Accordingly, the Department of Industries intends to make experiments with a view to devising the best method of glazing the pottery which is now being manufactured.—(*J. Ind. Indust.*, Nov., 1921.)

GENERAL.

British Fine Chemicals.—The Association of British Chemical Manufacturers has just issued a pamphlet containing an alphabetically arranged list of fine chemicals, and separate lists of indicators and dry microscopic stains, which are produced by some of its members. Although the list covers 40 pages (8½×5½ in.) and includes over 1700 products (among which are potassium bitartrate, citric and tartaric acids), it is not to be regarded as a complete catalogue of the fine chemicals made in this country, rather is it a list of products made by a certain section of the members of the Association. The names and addresses of 38 firms of manufacturers are given and numbered, and against each product

are placed the numbers of the firms manufacturing it. This new pamphlet is in succession to and far more complete than that entitled "British Research Chemicals," issued by the Association in 1920, and it is hoped that all who recognise the paramount necessity for establishing an independent and virile fine-chemical industry in this country, and the valuable work which was done by the young industry during the war, will consult it as occasion presents itself and act in the spirit of these considerations. Inquiries should be addressed to the Association at 166, Piccadilly, London, W. 1.

British Association Reprints.—The second of the new series of Reprints just issued by the British Association for the Advancement of Science is a report of the discussion which took place at the Edinburgh meeting last September on the Structure of Molecules. Occupying only five octavo pages, it is, of course, somewhat condensed; but it has been carefully edited and gives a useful account of a very interesting discussion in which, of course, Dr. Irving Langmuir was the chief figure. These new reprints, conspicuous in an orange paper cover, will be issued at varying prices and will be on sale at the office of the British Association, Burlington House. The price of the one under notice is 9d. The British Association Annual Reports in the past have been somewhat like Blue Books—the repository of some valuable things which deserved more currency, and might easily have obtained it if they had been disembodied and brought into view among current literature. The sale of anything that has to be ordered from an office is bound to be restricted. In any case it should be made clear whether prepayment is necessary and if there is a charge for postage.

British Non-Ferrous Metals Research Association.—An account of the research work undertaken for the Association in the national and university laboratories in various parts of the country is given in the (second) annual report for 1921. The effect of impurities (up to 1 per cent.) on the working properties of copper is being examined by Dr. W. Rosenhain, at Manchester University; Prof. F. C. Thompson and Mr. E. Whitehead are studying the behaviour of "nickel-silver" alloys from the manufacturing standpoint, and Prof. T. Turner and Mr. E. A. Bolton (Birmingham University) are investigating the cause of the red stains and smears on the surface of finished brass. Mr. W. H. J. Vernon is studying the atmospheric corrosion of brass and other non-ferrous metals at the Royal School of Mines, and Prof. C. H. Desch and Mr. D. Lewis have started research on metal polishing and grinding at Sheffield University. A review of foreign practice in the electric smelting of non-ferrous metals is being prepared by the information bureau, and Mr. A. G. Lobley has undertaken an experimental study of refractory resistors made of carborundum at Manchester University. Information is being collected in preparation for a research on methods of jointing metals, including brazing, soldering, and welding, and an extensive programme of research on the factors affecting the quality of castings is in charge of a research committee. Considerable progress has been made in the work on the corrosion of aluminium and its alloys, carried out under the supervision of Dr. G. D. Bengough, and an investigation on the determination of alumina and its influence on aluminium and its alloys is also to be undertaken. Copies of eight reports issued during 1921 can be obtained by members from the Secretary of the Association (71, Temple Row, Birmingham).

At a meeting held in Birmingham to promote the work of the Association, Mr. T. Bolton announced that the Association hoped to found temporary research fellowships for post-graduates at the

universities. With such fellowships, some of the minor researches could be carried out at small expense and promising workers would be attached more closely to the industry.

New Glass-Bottle Factory in Argentina.—A new factory with a daily capacity of 15,000 wine bottles is being erected in Mendoza, the centre of the Argentine wine industry. Sand of excellent quality for glass-making is said to be available locally, and oil from the province of Mendoza is to be used as fuel.—(*U.S. Com. Rep.*, Jan. 23, 1922.)

Reported New Nitrate Deposit in Chile.—The discovery is reported of a new nitrate zone in the Province of Tarapaca, to the east of the fields now being worked. It is claimed that the new beds underlie an area of 772 sq. miles and that blasting at forty points from 1 to 1½ miles apart has revealed beds of *caliche* 2 to 3 ft. thick at a depth of 11 ft. and containing from 20 to 40 per cent. of sodium nitrate. The Chilean Government has sent a mining engineer to investigate, and should the report prove correct, it will grant the discoverer a tract of nitrate land about 5½ miles square as a reward.—(*U.S. Com. Rep.*, Dec. 19, 1921.)

Sulphur in the New Hebrides.—Vanua Lava, an island in the Banks group of the New Hebrides, consists of a mountain 1600 ft. high, composed of sulphur 99 per cent. pure. Twenty-five years ago the sulphur was extracted by a French company, but exploitation was suspended because an Australian engineer held a prior right to the deposit. Now, however, a British-Australian company is negotiating with the Franco-British administration of the New Hebrides for authorisation to extract the sulphur.—(*U.S. Com. Rep.*, Dec. 19, 1921.)

New Electric-Steel Plant in Brazil.—Brazil possesses enormous reserves of iron ore, but the output of pig iron is not more than 40 tons per day and steel is made only in a small foundry in the State of San Paulo. Now, however, in order to utilise surplus power from its hydro-electric plants, the Empresa Força e Luz de Ribeirão Preto has formed a subsidiary company, the Cia Electro Metallurgica Brasileira, to construct and operate a steelworks at Ribeirão Preto. The plant is being made to American designs and is thought to be the first for producing steel from iron ore to utilise electricity as the sole source of power and heat; it is described in *Chemical and Metallurgical Engineering* (Dec. 7, 1921), and will include two furnaces of the Swedish type, two 6-ton Bessemer converters, one 6-ton Ludlum steel furnace, and two rolling mills, all to serve as the nucleus for a larger plant. Iron ore is to be obtained from the Morro do Ferro, a mountain about 75 miles away, which is a huge deposit of hematite covered with broken ore containing 65–67 per cent. iron, equivalent to 93–96 per cent. Fe_2O_3 . Brazilian charcoal is to be used and eucalyptus forests will be planted to supply fuel. It is hoped that the furnaces will be blown in not later than March, 1922.

Vegetable Oils as Fuel for Internal-Combustion Engines.—Much attention has been paid in Belgium to the utilisation of vegetable oils as a source of motive power (*cf. J.*, 1921, 90 R). Recent trials carried out by M. Mathot indicated that vegetable oils were perfectly suitable for use as fuel in two-cycle and four-cycle semi-Diesel engines. The consumption per h.p.-hr. for powers between 12 to 35·7 b.h.p. varied as follows:—Palm oil 290–328 grams, cottonseed oil 260–341 g., castor oil 240 g., heavy mineral oil 236–293 g. Groundnut, sesamum, castor, and other vegetable oils are to be tested similarly. Castor oil seems to offer special advantages as it is excellent both as fuel and lubricant. The engines tested ran satisfactorily on vegetable oils, but improvements in mechanical construction are required.—(*Bull. Mat. Grasses*, Nos. 7–8, 1921.)

CORRESPONDENCE.

CHEMICAL WARFARE AND THE WASHINGTON CONFERENCE.

SIR,—In the *Review* of February 15, under this heading, Sir Edward Thorpe deals with the resolution passed at Washington banning the use in warfare of "asphyxiating or deleterious gases" among the leading nations. It is with considerable diligence that I question the conclusions of one so deservedly famous in the chemical world, but Sir Edward Thorpe appears to have arrived at conclusions which, because they are based on erroneous assumptions, are entirely misleading.

I venture to think that any person who gives the matter calm thought and unprejudiced investigation will speedily establish that asphyxiating and deleterious gases when used in warfare are no more cruel or inhuman than any other weapon of war, but are, on the whole, a slightly less horrible form of extermination than shell-fire. First-hand evidence may be obtained from anyone who has actually experienced (and survived) both forms of frightfulness; or by an examination of the casualty statistics of the American army. This army entered the arena when chemical warfare was well advanced, and the figures concerning it are more comparable than those concerning the other belligerents. I have little doubt that the introduction of gunpowder met with the same arguments for its abolition as those now advanced against chemical warfare. Human nature is inherently conservative, even in its methods of self-extermination.

As the Conference has banned the use of poison-gases it must logically pass laws prohibiting all conceivable, and (more difficult) the still more deadly unforeseen, discoveries which may be made before the next war. "The wave of sentiment now rolling round the world," which the writer cites, does not in my opinion spring from disgust at chemical warfare, but is concentrated against all warfare; and to divert this laudable feeling into futile and unproductive channels is pitiful. The passing of useless edicts lulls into a sense of false security.

Sir Edward Thorpe rightly lays great stress on public opinion, but even the efficacy of this is questionable when your opponents gain a swift victory by surprise tactics. Had Germany been less clumsy in her initial methods of using gas, she would not have worried about international rage. Everyone may not agree with the last point but, I repeat, why is so-called chemical warfare alone singled out for opprobrium?—I am, Sir, etc.,

Walton-on-Thames, F. T. WALKER.
Feb. 21, 1922.

PERSONALIA.

Dr. A. H. Salway has resigned his position as chief research chemist to Messrs. Lever Bros., Ltd.

Dr. Raymond T. Miller, of Jefferson Medical College, Philadelphia, Pa., has been appointed professor of pharmacology and physiological chemistry in the College of Medicine of Baylor University, Dallas, Texas.

Dr. E. F. Nicholls, who recently resigned the presidency of the Massachusetts Institute of Technology owing to ill-health, has resumed the directorship of pure science in the Nela Research Laboratory of the General Electric Company.

The following appointments are announced from Germany:—Professor Schucht, of the Prussian Geological Survey, to the chair of geology, mineralogy and soil science in the Agricultural "Hochschule"

in Berlin; Prof. W. Trendelenburg, of Tübingen, to succeed the late Prof. M. Verworm as professor of physiology in the University of Bonn, and in the same university Prof. P. Trendelenburg, of Rostock, to succeed Prof. H. Leo as professor of pharmacology. Prof. Arthur Fischer, of the Technical "Hochschule" in Aachen, has been appointed head of the chemical division of the State "Materialprüfungsamt" in Berlin.

With great regret we record the death of Dr. Benjamin Moore, Whitley professor of biochemistry in the University of Oxford, on March 3, at the age of 55 years.

The deaths are announced from Germany of Dr. Reinhard Mannesmann at the age of 66 years; of Dr. Ludwig Schmidt, who was technical director of the Chemische Fabrik Griesheim Elektron for over 25 years; and of Dr. W. Fahrion, editor of the *Chemische Umschau* and well-known for his work on the chemistry of fats and tanning materials.

PARLIAMENTARY NEWS.

Zinc Concentrates.

In committee of supply on the supplementary estimates, Sir W. Mitchell-Thomson said that the Government now held 786,092 tons of concentrates and slimes and 2286 tons of spelter, and that the losses incurred on concentrates had been about £500,000 and on spelter £2200. The Geddes Report stated that the total losses were "almost certain to run into several millions," but as the world production of spelter had not exceeded 700,000 tons since the armistice (600,000 t. in 1921 against 977,000 t. in 1913) there was scope for a rise in prices. The present state of British zinc-mining was not due to the contracts made with the Australian producers. The British pre-war consumption of spelter was 200,000 t. per annum and the output of zinc ores in Great Britain was 17,300 t. (in 1913), of which 11,200 t. was exported, and only 6100 t., equivalent to roughly 2000 t. of spelter, was consumed in this country. When the contracts were made prices were practically double what they were now and no such decrease as had occurred could have been anticipated.

Mr. Betterton remarked that the Government had contracted to take a quantity rising from 250,000 to 300,000, whereas the total smelting capacity of this country was 170,000 t. The Australian producer had been subsidised for 10 years, therefore the English producer should be treated in the same way, otherwise when trade revived the British zinc mines would be water-logged and unable to produce. Sir C. Lowther pointed out that if zinc mining were stopped it would also affect lead mining, for both ores were generally worked together and the profits made on the zinc were often the sole profits, the lead merely paying the working expenses. The admixture of British and Australian ores for smelting gave a better and cheaper product than Australian ores alone. Mr. Baldwin said that the contract could not be cancelled, but it would be ended as soon as possible; it did not affect the home industry for the present world-price of spelter precluded its manufacture in this country.

In reply to Lt.-Com. Kenworthy, Mr. Young said that an advance of £500,000, secured by debentures and repayable out of a sinking fund, was made to the National Smelting Co., Ltd., towards the cost of erecting a factory to convert zinc concentrates into spelter, to be worked in conjunction with an adjoining Government factory for roasting concentrates and manufacturing sulphuric acid. No recovery had so far been found possible.

Sir W. Mitchell-Thomson, answering Mr. H. Jones, said that the Zinc Producers' Association had been appointed agents for resales of zinc concentrates in Australia and east of Suez, and the British Metal Corporation, Ltd., had been appointed agents for sales in Europe and west of Suez, at a remuneration varying from 4 to 5 per cent. on the business done.

Replying to Mr. H. Jones, who had asked whether the contract had enabled Australian zinc-mining companies to pay dividends, Sir W. Mitchell-Thomson said that in 1921 only 3 out of 11 of those companies paid dividends on their ordinary shares.—(Feb. 21, 22, 28, Mar. 1.)

The Beet-sugar Factory at Kelham.

The following is the substance of a reply made by Sir A. Boscawen to Mr. Royce:—The financial position of the beet-sugar factory at Kelham gives cause for anxiety. Owing to the high cost of erecting the factory the company's capital was exhausted by the end of 1921, and the directors applied to the Government for permission to borrow up to £200,000 in priority to the second mortgage held by the Government, and for a remission of the excise duty on home-manufactured sugar. The special committee appointed by the Ministry of Agriculture and the Treasury to consider the application recommended that the first request be not granted, and pointed out that a remission of excise duty would amount to a subsidy on beet-growing of £24 per acre. The Government has decided to act on the report of the committee. Owing to the high cost of production the directors are not making any contracts with farmers for the growing of beet this season. The Government holds half the issued share capital (£500,000), has advanced £125,000 on a second mortgage, and guaranteed a dividend of 5 per cent. for ten years on the shares held by the public; but this guarantee ceases if the company goes into liquidation or ceases to manufacture sugar.—(Feb. 22.)

Department of Scientific and Industrial Research.

Mr. Balfour informed Mr. Raper that 70 non-service males and 118 women were engaged in the Department; 59 males were doing industrial work and 109 women were not replaceable by ex-service men as they were clinical-thermometer testers, typists, etc.—(Feb. 23.)

Coal Exports.

Mr. Bridgeman, in answer to Major Kelley, stated that British coal exporters were recovering their trade in Europe and South America, and that the exports to the Continent had increased from 4,200,000 t. in the first quarter of 1921 to 8,600,000 in the last quarter, whereas American exports rose from 1 million tons in the first quarter to 2,600,000 tons in the second, but fell to only 1000 t. in the last. British exports to South America increased from 270,000 t. in the first quarter to 600,000 t. in the last, and American exports declined from 520,000 t. to 130,000 t. Recent prices of British and American coal at Genoa and Buenos Ayres had been:—Genoa: Cardiff coal, 200–205 lire and 195 to 200 lire per ton; U.S. steam coal, 190–200 lire. Buenos Ayres: Welsh steam coal, 39s. 6d. to 42s. 6d. per ton c.i.f.; U.S. steam coal, about 38s.—(Feb. 27.)

British and French Imports from Germany.

Answering Mr. Doyle, Mr. Baldwin said that the total value of the goods imported into the United Kingdom from Germany during 1921 was £18,482,000, including:—Coal, £39,000; raw materials and articles mainly manufactured, £1,100,000; porcelain, china, and earthenware, £314,000; during the same year France imported

from Germany coal, coke and manufactured fuel (excluding coal from the Saar basin) valued at £1,344,231.—(Feb. 27.)

Reparation Duties.

Mr. Young, replying to Mr. Kiley, said that the Governments of France, Belgium, and Italy had not applied any legislation similar to the German Reparation (Recovery) Act and did not collect a reparation levy in any form.—(Feb. 28.)

Employment in Lead and Zinc Mines.

Dr. Macnamara stated, in answer to Mr. H. Jones, that in September, 1921, about 800 persons were employed in the lead and zinc mines of this country, compared with about 2700 in September, 1920; on January 10, 1922, 440 lead miners were unemployed.—(Mar. 1.)

British Farina Mills, Ltd.

Answering Mr. Royce Sir W. Mitchell-Thomson said that the Government held debentures and shares amounting to £322,573 and £25,000, respectively, in the British Farina Mills, Ltd. The company was in liquidation and a receiver had been appointed on behalf of the debenture-holders, as the debentures had not been redeemed.—(Mar. 1.)

Imports of German Salt.

Replying to Mr. Raper, who had observed that the United States' authorities had ordered the analysis of samples of all imported salt because of serious impurities found in the German product, Sir A. Mond said that very little household salt was being imported into this country from Germany; there was no evidence that this salt was so impure as to be dangerous to health, but further investigations were being made.—(Mar. 1.)

Curtailment of National Expenditure.

The Government has decided that the Department of Overseas Trade shall not be abolished, as proposed in the Geddes Report, but that its cost shall be reduced from £94,000 to £46,000. The Department of Mines is to be incorporated in the Board of Trade, of which Department the Secretary for Mines will become an Under-Secretary. The expenditure on agricultural education and research cannot be reduced owing to pledges given under the Corn Production (Repeal) Act.—(Mar. 1.)

Safeguarding of Industries Act.

Bills to Repeal the Act.—A Bill to repeal the Act was presented by Mr. A. Shaw on February 10, and the date of the second reading was fixed for April 7.

On February 14, Capt. W. Benn, in moving that leave be given to introduce a Bill, said that there was no evidence that the Act had resulted in the building up of a chemical trade for war purposes; it had led to the dumping of German gas mantles and increased the cost of drugs and certain medical appliances; and that it was harmful to our foreign policy and impedes the work of European reconstruction. The motion was opposed by Sir. R. Cooper, and on a division was lost by 170 votes to 92.

Administrative Staff.—No additional staff has been engaged by the Board of Trade to administer the Act, but the customs and excise staff has been supplemented by seven temporary clerks.—(Feb. 20.)

Iodol is not made in this country, but is a German product consumed here only on a small scale, consequently the price has tended to rise by the amount of duty imposed. An amendment to exempt such articles was considered during the committee stage of the Bill but was rejected.—(Feb. 20.)

Delay in Delivery.—Except in a few cases, delay in delivering articles dutiable under the Act has not been attributable to the customs officials.—(Feb. 21.)

Referee.—Mr. G. M. T. Hildyard, K.C., has been appointed referee to determine disputes arising under Sections 1 (4) (compound articles), 10 (value of goods), or 11 (determination of disputes) of the Act.—(Feb. 23.)

Preserved Manufactured Milk is not affected by the Act and is only subject to duty if it contains a dutiable substance added to it.—(Feb. 27.)

Calcium Carbide Case.—The name of the complainants in the calcium carbide case was published in an official notice. One junior counsel was briefed by the Board for the case and no fees were paid for a solicitor or expert witnesses. There were 10 sittings in all. The total cost of the inquiry cannot be stated.—(Feb. 27.)

Part II. Committees.—The reports of these committees will be presented to Parliament and published. In considering the reports the Board of Trade will attach due weight to any disagreement.—(Feb. 20.)

Orders under Part II.—No Orders have been made under this part of the Act, but eight complaints have been referred to special committees, and the report of one committee is being considered. Including complaints and inquiries with a view to formulating complaints, roughly 100 trades or branches of trades have communicated with the Board.—(Feb. 13, 20.)

Dyestuff (Import Regulation) Act.

In answer to several questions, Mr. Baldwin stated that the Dyestuffs Licensing Committee had found it necessary to ask applicants for import licences to furnish confidential information, such as the names of the foreign manufacturer and of the applicant's customer in this country, and the purpose for which the dye was required, but no complaints had been received. There was no reason to suppose that dye-users were dissatisfied with the work of the Committee. Applicants were advised to obtain dyes not made in this country from Switzerland rather than Germany, in view of the assistance afforded by the Swiss dye-makers to the British textile industry during the war.—(Feb. 27.)

Replying to various questions, Mr. Baldwin said that he had received no representations from textile-trade circles that the Dyestuffs Development Committee was not sufficiently active in promoting the development of the industry. The Committee was ascertaining exactly how far British makers could meet British requirements in dyes in order to decide the most important directions in which production should be developed. Such an inquiry was difficult, and it would not be right to ask the Committee for a report at this stage. If any members of the Colour Users' Association were dissatisfied with their representatives on the Advisory Committee they could take steps to bring about a change. The constitution of the Committee was prescribed by the Act and the appointment of a referee would be an unwarranted reflection upon the impartiality of the members of the Committee. Dissatisfied applicants, however, could appeal to the Board of Trade. Large stocks of dyes were imported from Germany before the Act was passed, and liquidation had probably been delayed by trade depression.

After full inquiry, the Committee decided that British-made lime green was not of inferior quality and that there was no important difference in price compared with foreign quotations. A licence to import Rhodamine B. was refused to Messrs. Hulso and Co. because the product was made in this country by the Clayton Aniline Co., which had not been granted a licence to import the dyestuff.—(Mar. 6.)

REPORTS.

MINES AND QUARRIES: GENERAL REPORT WITH STATISTICS, FOR 1920. By H.M. CHIEF INSPECTOR OF MINES. PART III.—OUTPUT. Pp. 89—121. London: H.M. Stationery Office. 1921. Price 1s. 6d.

The total value of the mineral production of the United Kingdom in 1920 was £427,444,884, the increase of £91,771,381 over the value for the previous year being due largely to inflated prices. Statistics of the quantities raised were given in Part I of the report (*cf. J.*, 1921, 239 R).

Coal.—The output of coal, 229,532,081 tons, was the lowest recorded since 1903, except in 1918, and the pithead price rose from 27s. 4'08d. in 1919 to 34s. 6'97d. in 1920. Owing to the short supply, exports (including coke, manufactured fuel and bunker coal) were reduced to 43'7 million tons, and 185'8 million t. was available for home consumption (compared with 189'1 mill. t. in 1913) or 79 cwt. per head of population. The consumption at gas works and coke ovens was 37,409,136 t.; and the total output of coke was 20,918,576 tons. The number of coke ovens in use rose by 167 to 15,400, of which 5384 were beehive ovens or 35 per cent. of the total compared with 37'4 per cent. in the previous year.

Iron Ore.—Although the production of iron ore improved by 452,800 t. to 12,706,895 t., it was over 34 mill. t. less than the output in 1913. Retained imports of iron ores, chiefly from Spain, totalled 6,500,911 tons. The returns for the pig-iron industry for 1919 and 1920 are as follows:—

	1920.	1919.
Works in operation	116 ..	120
Furnaces built	481 ..	490
Furnaces in blast	284'58 ..	279'66
	Tons.	Tons.
Pig iron made	8,034,717 ..	7,417,401
Ore used	19,137,460 ..	19,044,272
Coal	2,062,370 ..	2,309,587
Coke	10,070,509 ..	9,384,337

Iron Pyrites.—Production fell to 6659 t., and 630,564 t., chiefly cupreous iron pyrites, was imported.

Gold and Silver.—Gold was obtained from St. David's mine in Merionethshire, and silver solely from silver-lead ore.

Copper Ore.—The imports were:—Ore, 28,560 t.; scrap, 1793 t.; metal (bars, plates, etc.), 113,032 t.; copper sulphate, 96 t.

Lead Ore.—A total of 5852 t. ore and 136,394 t. metal was imported, in addition to 751 t. of red lead and 12,283 of white lead.

Manganese.—Carnarvon and Merioneth supplied 12,875 t. of manganese ore and 452,612 t. was imported.

Oil-shale.—The average price at the mines rose from 11s. 4'0d. to 14s. 7'7d. per ton. In Scotland the average yield of oil is 20 galls. and of ammonium sulphate 40 lb. per ton of shale.

Petroleum.—During the year 2909 barrels or 375 t., valued at £8437, was obtained at Hardstoft (Derbyshire). Up to the end of 1920 this well had yielded 590 tons. Imports increased by 157,962,284 gallons to 879,379,128 galls., valued at £66,554,038.

Mercury.—The quantity of mercury imported was 2,682,016 lb., of which 1,452,293 lb. was re-exported.

Salt.—A total of 378,561 t. of salt was exported, showing an increase of 33,352 t. over the previous year.

Tin Ore.—Imports comprised 52,718 t. of ore and 15,631 t. of metal; 14,877 t. of metal was exported.

Tungsten Ores.—The total output of tungsten ore in Cornwall was 91 t. and in Devon 3 t.; the average metal content of the dressed Cornish ore was 52'2 per cent.

Zinc Ore.—The imports retained included 36,827 t. of ore, 106,680 t. of crude and manufactured zinc, and 5748 t. of zinc oxide. The export of British and Irish produce was 4292 t. of ore, 10,177 t. of metal, and 1773 t. of oxide.

Production of Metals from Home-Produced Ores and Mean Monthly Prices During 1920.

Metals	Production.		Average monthly price during 1920.	
	1919.	1920.	£	s. d.
	Tons.	Tons.		
Pig iron ..	7,417,401	8,034,717	..	—
Cleveland No. 3	—	—	..	10 6 0
For export ..	—	—	..	12 13 11
Copper ..	144	127	..	—
Electrolytic ..	—	—	..	110 10 0
Best selected ..	—	—	..	107 11 9
Standard ..	—	—	..	97 12 5
Lead ..	10,277	10,961	..	38 4 7
Tin ..	3,272	3,065	..	296 1 7
Zinc ..	2,436	1,655	..	45 4 6
	Fine oz.	Fine oz.		
Silver ..	68,414	76,344	..	5 1 9/16
Gold ..	—	34½	..	—

REPORT ON THE FINANCIAL AND ECONOMIC CONDITIONS OF THE ARGENTINE REPUBLIC, DATED SEPTEMBER, 1921. By H. O. CHALKLEY, H.M. Commercial Secretary, Buenos Ayres. Pp. 65. Department of Overseas Trade. London: H.M. Stationery Office. 1921. Price 1s. 3d.

Readjustment to normal conditions in Argentina is taking place without much economic dislocation. The export trade was very good in 1920, but in 1921 it tended more towards the pre-war level, the exports being smaller and more evenly distributed; their estimated value in 1920 was £201,360,000, or about the same as in 1913. The exports in 1920 included:—Hides and skins, 3,411,792; quebracho, logs, 56,582 metric tons, extract, 122,837 t.; and tallow, 21,549 t. Numerous import orders were cancelled, but abundant stocks of foodstuffs and raw materials make the country's economic position a strong one, and the excess of imported goods is gradually being liquidated. Imports in 1920 had an estimated value of £170,820,000 (£129,855,000 in 1919), and included British goods worth £42,839,819, an increase of £21,622,605. The figures for imports in 1920 are not yet available, but in 1919 they included:—Iron and steel, £7,514,309; coal, cement, sand, bricks, etc., £9,701,312; glass, porcelain, china, £1,107,379; chemicals and drugs, £8,016,441; oils, fats, petroleum, petroleum products, £7,116,777; paint, varnish, dyes, ink, £1,067,097; tinplate, copper, lead, zinc, manufactures of, £2,505,213.

British goods and methods of business are still preferred, and it is probable that trade with this country will regain its former pre-eminence. Although Argentina is such an important market for manufactured goods, the imports are intended rather for private consumption than for productive purposes. German firms are making every effort to regain trade, and are quoting prices which exclude competition; complaints, however, have been made of the quality of German materials.

Manufacturing industries are few, and their development is hindered by lack of iron, coal, and water-power. Although they expanded during the war it is thought that this development will not affect the importance of the Argentine market to British manufacturers in the near future. Out of a total population of 7,885,237 in 1914, 150,013 people were employed in manufacturing industries, including 23,968 in metallurgical industries, 10,542 in chemical and allied industries, and 21,840 in the leather industry.

Hides and quebracho are available in large quantities, but the products of the tanning industry are of low grade, and there is no prospect

that Argentina will export even low-grade leather in the near future. The sugar crop in 1920 was 198,061 metric tons, and the estimate for the 1921 crop—220,000 t.—has been reduced by 20 per cent. owing to frost (*cf. J.*, 1921, 352 R). Forests of valuable timber, mostly unexploited, cover about one-fifth of the area of the country. The yield of cotton in 1920—21 rose by 75 per cent. to 18,000 t., but the product is not sufficiently uniform or well-known to be easily marketable. The dairying industry is making progress, and the export of casein increased from 5775 t. in 1920 to 10,000 t. in the first half of 1921. With the exception of petroleum, there is little likelihood that the mineral resources will be developed in the near future. The output of petroleum has risen from 209,328 t. in 1919 to 241,681 t. in 1920, and the output in 1921 is expected to be still larger; the production does not, however, yet meet local requirements, and large importations are necessary (*cf. J.*, 1920, 402 R; 1921, 36, 158, 237, 297, 314, 352, 415, 478 R).

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for February 28 and March 2.)

TARIFF. CUSTOMS. EXCISE.

British India.—For assessment of customs duty, "perfumed spirits" are defined as "a mixture containing only alcohol, water, and essential oil or attar with, possibly, a little liquid ammonia or neutral colouring matter, and of an alcoholic strength not falling short of proof spirit."

Dutch East Indies.—It is proposed to increase the import duties by 25 per cent. on copper, earthenware, porcelain, glass, products of iron, steel, lead, paper, petroleum, perfumes, paint, salt, tinplate, and certain organic chemicals. A similar increase in export duties is proposed, but copra and coconut oil will not be affected until May 1 and rubber not at all.

Egypt.—Import tariff valuations for non-ferrous metals are given in the issue for March 2.

Federated Malay States.—The revised import duties on matches are given in the issue for February 23. The duties on exported tin, tin ore, slag and hard-head have been revised.

Gambia.—Regulations have been issued controlling the importation and storage of petroleum and other inflammable liquids.

Germany.—Import licences are no longer required for certain residues of animal fats, dextrin, starch, starch sizes, gluten, various sugars, vinegar, molasses, etc.

Holland.—Export prohibitions have been withdrawn from milk products, casein, etc.

Italy.—Export prohibitions have been withdrawn from charcoal, gold and silver ingots (including those containing platinum), petroleum and petrol. Licences are not required for the importation of dyes for use in chemical laboratories for microscopical and biological purposes. Surtaxes, in addition to the customs duty, have been applied to imported sugar.

Latvia.—Customs duties under the new export tariff are generally lower than those previously in force. Information on rates for particular products may be obtained from the Department.

Kenya.—A tax of 12½ cents per gallon is applied to imported petroleum having a flash-point below 76° F.

Martinique.—Regulations have been issued controlling the importation of, and trade in, poisonous

substances, including opium, morphine, diacetylmorphine, cocaine, and hashish.

Morocco (French).—Consumption duties have been levied on explosives manufactured in or imported into the French zone varying from 0.50 to 4 fr. per kg.

New Zealand.—It is proposed to insert the words "current domestic value" wherever the words "fair market value" occur in the Customs Act.

Norway.—The sugar monopoly will be abolished from April 15.

Paraguay.—The duty on exported quebracho extract has been reduced from \$3 to \$1.50 (gold) per metric ton.

Portuguese East Africa.—"Contribution taxes," additional to import dues, are payable on imports of spirits, alcohol, edible oils, perfumery, petroleum, gunpowder, soap, candles, vinegar, and salt.

Spain.—A full translation of the new customs tariff, which came into force on February 13 and 16, is given as a supplement to the issue for February 23. Most chemicals and pharmaceutical products are affected.

Switzerland.—By special decree, increased tariff rates will be applied to goods from countries which subject Swiss goods to particularly high duties or which treat such goods less favourably than those of other countries.

Tanganyika Territory.—Drugs, medicines, and rectified spirits imported solely for medicinal use are admitted free of duty.

Tunis.—The "general" tariff rate of duty on potassium chloride and sulphate has been fixed at 30 francs per 100 kg.

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Australia ..	Paper	233
British West Indies ..	Cement, bottles	234
Canada ..	Tin, tin oxide, sheet zinc and copper, brass, aluminium ingots, spelter, borax, sal-ammoniac, soda ash ..	235
" ..	Drugs, fine and heavy chemicals, china, glass ..	239
Kenya Colony	Equipment and chemical stock for a sugar-mill laboratory ..	7980/E.D./S.C.2
South Africa	Drugs, pharmaceutical chemicals, photographic materials ..	209
Belgium ..	Artificial leather ..	214
Finland ..	"Rustless" iron and steel ..	215
France ..	Tallow, stearin, fats for soap-making	215
" ..	Black-plate, tinplate	219
Holland ..	Glassware, fine earthenware and porcelain ..	252
Latvia ..	Soap, technical fats, chemicals, fertilisers, oils, coal ..	216
Sweden ..	Soya-bean oil, linseed oil, oils for soap-making	257
Switzerland ..	Leather	223
" ..	Medicinal specialities	258
Yugoslavia ..	Tinplate, solder, etc. (tender for)	7400/F.E. P.N.
United States	Bones and fertilising products ..	226
" ..	Industrial chemicals, especially soda ash, caustic soda and sodium, potassium, calcium and barium compounds; cyanides, pigments, mineral colours, pottery clays, linseed oils, chemicals used in rubber manufacture	263

GOVERNMENT ORDERS AND NOTICES.

PROPOSED NEW REGULATIONS FOR CHEMICAL WORKS.—The draft Regulations for chemical works issued in December, 1920 (*cf. J.*, 1921, 16, 28, 39 n), have been revised by the Home Secretary after consideration of objections and suggestions submitted by the industry. It is understood that the revised draft is accepted by the Association of British Chemical Manufacturers and other organisations. The principal alteration is the withdrawal of Regulations 12 to 15, which required provision for the welfare of the workers to be made in all works to which the code applies. Owing to the industrial depression, the Home Secretary has reluctantly agreed to limit for the present such provision to workers employed in processes involving special danger to health, and to postpone the operation of certain regulations involving structural alterations. Copies of the revised draft regulations may be obtained from the Factory Department, Home Office, S.W. 1, and any objections must be sent to the Home Secretary before March 24.

GAS (CARBON MONOXIDE) ORDER, 1922.—The Board of Trade has issued a Special Order, dated February 16, under Section 2 (4) of the Gas Regulation Act, 1920, prohibiting gas undertakings as defined in the Act from supplying any gas containing carbon monoxide for domestic purposes unless such gas possesses the distinctive pungent smell of coal gas.

SAFEGUARDING OF INDUSTRIES ACT, Pt. I.—The award of the Referee that calcium carbide is properly excluded from the schedule of dutiable articles was signed by him on February 25.

Complaints have been received that barium peroxide of 80 per cent. strength and over and anhydrous sulphurous acid have been improperly excluded from the lists of dutiable articles.

TRADE NOTES.

BRITISH.

Trade of Canada in 1921.—The following statistics show the volume of the import and export trade of Canada in 1921, together with the percentages derived from, or directed to, the United Kingdom and the United States:—

	Imports.	From U.K. U.S.	Exports.	To U.K. U.S.
	\$	% %	\$	% %
Wood, wood products, paper ..	33,239,672	7.2	186,092,091	8.9
Iron and products of ..	127,470,117	7.7	32,629,912	15.4
Non-ferrous metal products ..	31,469,401	8.7	27,214,004	21.2
Non-metallic mineral products ..	153,017,057	4.3	25,034,872	14.9
Chemicals & allied products ..	23,588,535	13.1	10,086,477	8.5
Total ..	799,391,598	15.4	802,609,820	37.7

Compared with 1920 the imports have declined by 40 per cent., and the exports by 37 per cent. —(*Commercial Intelligence Journal, Canada, Jan. 30, 1922.*)

FOREIGN.

The United States as a Market for German Chemicals.—Prior to the war the United States was the chief market for German chemicals. In 1920, however, out of a total export of chemicals worth 8958 million mk., consignments to the United States were valued at 1145 million mk. only, and in 1921,

reckoning on the basis of the figures for the 6 months May to October, the value was only 350 million mk., or one-sixteenth of the value in 1913. The following table shows the German exports of chemicals to the United States in 1913 and 1920, together with the export of chemicals to all countries in the latter year; the estimated exports to the United States in 1921 are given in parenthesis:—

	Total Export. 1920.	Metric tons. Export to U.S.A. 1920.	Export to U.S.A. 1913.
Coal-tar dyes	17,847 ..	402 (224) ..	13,855
Allizarin dyes	3,325 ..	199 (92) ..	2,665
Indigo	— ..	— ..	3,461
Yellow ochre, umber, mineral colours	20,206 ..	737 ..	—
Bronze powders	833 ..	223 ..	602
Zinc white	— ..	— ..	2,098
Essential oils, camphor, menthol, etc.	129 ..	4) (30) ..	271
Synthetic perfumes	149 ..	15) ..	184
Wood alcohol	— ..	— ..	384
Potash salts, crude	— ..	319,145 (28,010) ..	812,537
Lactic, acetic and citric acids, lactates	1,974 ..	197 (1,056) ..	—
Barium chloride	1,218 ..	258 ..	—
Potassium carbonate	3,885 ..	587 (1,588) ..	7,835
.. chloride	2,253 ..	502 ..	—
.. nitrate and barium nitrate	4,747 ..	742 (450) ..	—
Potassium manganate and permanganate	165 ..	39 ..	—
Potassium ferro- and ferri- cyanide, sodium and potassium cyanides	1,539 ..	720 (1,640) ..	2,502
Zinc salts, zinc chloride	613 ..	190 ..	—
Arsenious acid and its compounds	2,583 ..	1,200 (218) ..	—
Potassium sulphate, chlo- ride, and potassium- magnesium sulphate	158,368 ..	68,960 ..	53,674
Potassium hydroxide	— ..	— ..	3,817
Carbides of aluminium, silicon, etc.	— ..	— ..	1,820
Ammonium sulphate	— ..	— ..	6,360
Salicylic acid, salantonin, benzoic acid, potas- sium benzoate, pyridin, barium and sodium compounds	22,767 ..	1,512 (7,746) ..	4,530
Sal ammoniac	2,423 ..	497 ..	—
Alkaloids	74.7 ..	11.9 (6.2) ..	48
Gelatin	133 ..	52 ..	484
Glue	— ..	— ..	2,318
Medicinal chemicals	284.6 ..	14.2 (54) ..	100
Quinine salts	— ..	— ..	63
Photographic chemicals	— ..	— ..	552
Coal tar, coal-tar oils and products	— ..	581 (120) ..	2,097
Aniline oil and salts	— ..	— ..	2,428
Paraffin wax	— ..	— ..	8,713
Calcium nitrate	— ..	— ..	23,198
Lead compounds	— ..	— ..	8,807

* Practically nil. † No statistics kept.

The exports of potassium sulphate and potassium-magnesium sulphate in 1920 to the United States were valued at 430 million paper mk., and, including exports of other potash salts, constituted by far the most important item of the German trade in chemicals with the United States. Products which are assuming more importance in the export trade are alkali metals, lactic, citric and acetic acids, barium chloride, potassium nitrate, barium nitrate, potassium manganate and permanganate, zinc salts, nitrite, and sal-ammoniac. Most ground has been lost in the trade in potash salts and dyestuffs, and the new American tariff makes it unlikely that much trade can be done in sodium hydrate, dyestuffs and intermediates. In 1920 decreases were shown in the exports of coal-tar products, *e.g.*, naphthalene, anthracene, and phenol, but in September, 1921, there was a recovery in the export of light coal-tar oils, especially benzol, cumine and anthracene oil; in both years there were no exports of aniline oil and salts. Bromine and iodine and their compounds began to figure in the exports to the United States in 1921. From a consideration of the quantities and gold values of the exports, it appears that the United States is no longer the chief market for German chemicals.

REVIEWS.

BLEACHING AND RELATED PROCESSES AS APPLIED TO TEXTILE FIBRES AND OTHER MATERIALS. By J. MERRITT MATTHEWS. Pp. xi+676. (New York: Chemical Catalog Co. 1921.) Price \$8 net.

The book is divided into 32 chapters dealing with: the wool fibre, scouring of wool, bleaching of wool, boiling off and bleaching of silk, boiling out and bleaching of cotton, faults in cotton bleaching, bleaching of linen and other vegetable fibres, stripping of dyed materials, and materials used in bleaching. It is the most complete treatise on the subject which has yet appeared and has entailed a large amount of work for its compilation. The preparation has evidently taken a long time and it is noticed that recent research work has not received the attention that earlier work has obtained, but, perhaps, a new edition will not incur this criticism. It is stated that no revolutionary changes have been made in the bleaching industry during the last hundred years, and perhaps this is the greatest compliment we can pay to our predecessors in the industry, although the author explains it by hinting that the bleaching industry is a great industry *in esse* and a scientific industry *in posse*. The rejection of the lime boil by Americans in favour of the caustic-soda boil can hardly be regarded as progressive, for bleaching was done in the earliest times with impure caustic potash and caustic soda and, more recently, caustic soda has been adopted because the Leblanc process provided a cheaper article. Little help can be expected from science until we know more about the non-cellulose constituents of vegetable fibres, and until this information is forthcoming progress in the industry will depend largely on trials which are variously called "hit and miss," "rule of thumb," or "empirical." The position, however, is very clear: progress in the bleaching industry will depend on research in plant physiology and in bio-chemistry; and it is for this reason that co-operative research in the cotton industry is so pressing.

The treatment of animal fibres along with vegetable fibres cannot be justified, as the two classes of fibres interest two distinct groups of technologists. The solvent extraction process for wool is given very thoroughly and can be commended to wool scourers in England, where hitherto the process has not made headway because of the supposed detrimental action of the process on the fibre. The modern process of bleaching cotton cloth is called the "American Process" by the author, but should it not be named the "Bolton Process" for it was developed by J. Brooks at Sunnyside, Bolton? He used the rope washing machine, whereas hitherto the dash-wheel had always been employed for washing.

Little points worthy of notice in the book are the questionable figures given on p. 195 for the analysis of the cotton fibre, the lack of adequate discussion of a number of researches on the effect of the bleaching process on the strength of cotton yarns, the distinction placed on the fats and waxes of vegetable fibres whereas they are usually considered together. The chapter on linen bleaching is well done considering the published material available, but it gives little indication of modern methods in the industry. The inclusion of the treatment of these special fibres in the book can only be justified on the grounds stated by the author, that he wants Americans to become interested in them. The author's method of dissolving bleaching powder is of interest, and it is worthy of note that, after considering all the evidence, he supports the view that the bleaching action of hypochlorite solutions depends on the hypochlorous acid in the solutions.

The above remarks are intended to be of use in preparing a second edition, which it is hoped will soon be called for, since the book will be useful to the student, the textile chemist, and those engaged in the bleaching industry. The author gives the whole of his experience and does not leave the feeling that he has withheld any practical points of importance.

S. H. HIGGINS.

THE ELECTRIC FURNACE. By J. N. PRING. *Monographs on Industrial Chemistry*, edited by Sir Edward Thorpe. Pp. xii+485. (London: Longmans, Green and Co. 1921.) Price 32s. net.

This volume will doubtless be found a useful book of reference by those interested in electrometallurgy; it is divided in twenty-five sections covering a very wide range of subjects.

After a brief historical survey of types of furnaces and accessory apparatus, laboratory furnaces are discussed in considerable detail, and other chapters deal with the electrometallurgy of iron and the non-ferrous metals. The manufacture of calcium carbide, nitrogen compounds, carbides, phosphorus, and other lesser-known electrochemical processes are also described in detail. The delicate subject of the capital and operating costs of electric steel furnaces is dismissed in less than one page, and this subject might advantageously have been either omitted or amplified considerably, as the few figures given are likely to mislead students of the economics of electric-steelmaking. The chapter on the design of electrode-terminals leaves much to be desired, and most of the diagrams represent early practice and omit recent improvements. Chapters on power-stations and details of the world's more important hydro-electric development complete the volume.

The subject matter, as a whole, leaves the reader in doubt as to the present state of electrometallurgical processes and presents a large amount of undigested information, with little differentiation between past and present practice. Much that is included in the later part of the book might well have been mentioned briefly in the historical section, or omitted altogether.

Recent developments in Great Britain have not received the mention they deserve, for in no country during the war did the regulation of power for the supply of electric furnaces receive more attention. Owing to the high cost of electric power and the shortage of energy available, great economy and control were necessary, but little mention of the question of regulation is made. The fact that four factories were established for the manufacture of amorphous electrodes and one for the preparation of graphite is not mentioned, although these works presented genuine advances in metallurgical science. Soderberg's electrode, which makes possible the continuous operation of alloy and carbide furnaces, is also an improvement of great importance which is omitted.

Among the furnaces used for the melting of non-ferrous metals, one is surprised at the omission of the induction furnace with the secondary vertically below the main bath of metal, which has been developed by Wyatt so successfully in recent years. This places at the disposal of the metallurgist new methods of employing electric energy for melting and mixing metals. This furnace has found wide application, and to-day hundreds are in operation for the treatment of alloys of copper and zinc.

The author has undoubtedly filled a hiatus in the list of books available for the technologist, and it is to be hoped that future editions will appear with fuller recognition of the valuable pioneering work

of Stassano, Héroult, and Kjellin, and a critical review of the improvements which have been made on these basic principles of electric-furnace construction. The present state of the electric-furnace industry is difficult to gauge from the segregation of valuable information which is crowded into this volume; future editions should distinguish more clearly between those processes which are of academic or historic interest only and those which constitute the basis of the young and thriving industries based on electro-metallurgy.

D. F. CAMPBELL.

KAUTSCHUCK UND FLECHTENSTOFFE. By E. FONROBERT, C. HARRIES, V. GRAFE and W. BRIEGER. PART XX. of ABDERHALDEN'S HANDBUCH DER BIOLOGISCHEN ARBEITSMETHODEN. Pp. 438. (Berlin and Vienna: Urban u. Schwarzenberg. 1921.) Price 120 marks.

Professor Abderhalden's new venture, the "Handbuch der Biologischen Arbeitsmethoden," is to take the place of his "Handbuch der Biochemischen Arbeitsmethoden," which was only completed in 1914. The new handbook is to cover all aspects of biology and to include such extremes as the "chemistry of the alkaloids" and "national psychology"! It is therefore gratifying to know that the book is to appear in a series of parts, each of which will be complete in itself. This arrangement has not been adhered to in Part XX., which is under review. There are no two branches of chemistry which differ so widely as the chemistry of rubber and that of the lichens. The lichen products may be of some interest to the chemist engaged in work on the tannins, but they are of no interest to the rubber chemist. Part XX. consequently does not meet the needs of the specialist, which is the main object of any handbook. This method of publishing different subjects in the same volume leads inevitably to overlapping, since Part XL (recently published), which deals with the tannins and the saponins(!), devotes also considerable space to lichen products.

Prof. Abderhalden is to be congratulated on having obtained such collaborators as Fonrobert, Harries, and Grafe, who deal with the section on rubber. They are all of outstanding eminence; Fonrobert as a practical rubber chemist, Harries as a founder of rubber chemistry, and Grafe as botanist. Fonrobert's article (pp. 1-138) deals with the different methods for the identification, purification and analysis of rubber. The subject is critically handled, and the article shows that the author has succeeded in improving a number of the methods. Caoutchouc, guttapercha, balata, bresk and chicarubber are, unfortunately, treated separately, which leads to frequent repetitions that could have been avoided.

The section dealing with the chemical constitution of rubber is by Harries (pp. 139-198). It gives an historical review of the chemistry of rubber since 1847, which might have been omitted. The handbook is primarily intended for laboratory work, as there is a number of first-rate books on rubber (*cf.* "Untersuchungen über die natürlichen und künstlichen Kautschukarten," by C. Harries) which give full accounts of its history. Harries' article contains an excellent bibliography and a number of his unpublished observations, which enhance the value of the book. Objection must, however, be made to the graphical formulæ which are given for many of the "synthetic" rubbers, as they leave an impression of finality which is misleading and does not represent the true position of the subject.

Section III. describes modifications of the methods of Harries, Weber and Budde, as proposed by Grafe for use in botanical work (pp. 199-204). How far

such a special chapter is desirable is difficult to judge, but the fact that it has been given, brings out with great clearness the atmosphere of repetition with which the whole handbook is impregnated. The part on rubber could have safely been reduced from 204 to about 100 pages without loss of efficiency.

The contribution by Brieger on the lichen products (pp. 205-438) is particularly gratifying, as up till now there have only been books written either by Zopf or Hesse, who are the exponents of two opposing schools. Brieger reviews the subject from the standpoint of the neutral, but his account suffers from the disadvantage that he is unable to speak with the authority of the specialist. The first part of Brieger's contribution (pp. 205-236) deals with general organic chemistry as applied to the study of the lichen products, and should have been omitted. Every organic chemist knows where to find, for example, information regarding the preparation of anhydrous hydrocyanic acid (p. 217), benzoylformic acid (p. 220) and other similar products, which are given in this section.

The second part of Brieger's article (pp. 237-438) deals with actual problems; it is very well written and gives in many places a comparison of the technique of Zopf and Hesse. The tables on pp. 242-361 present a comprehensive summary of the different lichen products and are of particular value. They contain, however, a few errors, e.g., on p. 260 the formula $C_{11}H_{14}O_6$ for acrometin should be $C_{11}H_{14}O_5$; and lepranthin is given as $C_{21}H_{28}O_{10}$, whereas the correct formula is $C_{21}H_{26}O_{11}$. Similarly the statement that Hesse's isidic acid is identical with Zopf's physodylic acid is inaccurate, since it is actually identical with Zopf's hirtellic acid. Reference must also be made to an error in the illustrations on p. 376. They are copied from a paper by Senf, which gives fig. 21 and fig. 22 as rhodophyscin and rhodoclanic acid respectively; Brieger shows them in the reverse order. The statement that picrorocellic acid (p. 361) has no effect on malaria is, perhaps, of interest, but since this is the only reference to the therapeutics of the lichen products it could have been omitted.

M. NIERENSTEIN.

KELLY'S DIRECTORY OF THE CHEMICAL INDUSTRIES. 1921. Fifteenth edition. Pp. xxxii+858. (London: Kelly's Directories, Ltd. 1921.) Price 30s. net.

The compilers of even the best trade or industrial directory are largely at the mercy of the firms whose names appear in its pages. The frontiers of many trades and professions are clearly defined; there is little doubt, for instance, as to whether a man is, or is not, a photographer or chiropodist (to mention two of the callings included in this work), but sometimes the line is less clear; the boundary between "manufacturer" and "merchant" is a little indefinite, and we fear that we could select from this volume one or two firms described as manufacturers whose claim to that title rests solely on their ability to supply the article in question. Probably nothing less stringent than a Government inquiry-form, furnished with the severe inducements to the avoidance of inaccuracy made familiar to us during the late war-period, would furnish the material for a perfect directory; failing this achievement we can acclaim the new edition of this well-known publication as representing the present high-water mark.

In describing a circle for the field of operation, the dual popular significance in this country of the word "chemist" has perhaps caused some hesitation in the choice of a centre, with a final decision in favour of the pharmacist. As a result we find included the hospitals, veterinary surgeons,

dentists, artificial-limb makers, and suppliers of the various articles which adorn the drug-store counter, such as sponges and tooth-brushes, whilst other industries, e.g., the production and supply of many kinds of plant of interest to chemical manufacturers, are omitted or dealt with much less fully. This orientation of the volume, rather than the personal prejudices of the publishers probably accounts also for the inclusion of mineral-water manufacturers and the exclusion of brewers.

The classification is occasionally at fault; no very definite distinction is drawn between various kinds of "colours" in certain sections; the suppliers of coal-tar dyestuffs and of mineral and other pigments are all included in the same list, either without any distinction being made or with the meaningless affix to a number of names of the term "chemical colours."

The directory is in most respects so well-arranged and of such great service that we could wish it even better, and a little criticism must be forgiven of a work of reference which, under the heading "Publications in connection with the Chemical Trades," ranges from the "Journal of the Chemical Society" to the "Australian Journal of Dentistry" and "Nursing Notes," but forgets to mention the Journal of the Society of Chemical Industry.

REGINALD BROWN.

PUBLICATIONS RECEIVED.

ISOTOPES. By DR. F. W. ASTON. Pp. 152. (London: Arnold and Co. 1922.) Price 9s.

THE ELEMENTS OF FRACTIONAL DISTILLATION. By C. S. ROBINSON. *International Chemical Series*. Pp. 205. (New York and London: McGraw-Hill Book Co., Inc. 1922.) Price 12s. 6d.

A CONCISE HISTORY OF CHEMISTRY. By DR. T. P. HILDITCH. Second edition, revised. Pp. 276. (London: Methuen and Co., Ltd. 1922.) Price 6s.

COLLOID CHEMISTRY OF THE PROTEINS. By PROF. W. PAULI. Translated by P. C. L. THORNE. Part I. Pp. 140. (London: J. and A. Churchill. 1922.) Price 8s. 6d.

MESSUNG GROSSER GASMENGEN. By L. LITINSKY. *Chemical Technology Series*, edited by PROF. A. BINZ. Pp. 274. (Leipzig: Otto Spamer. 1922.) Price, paper, 525 marks, bound, 585 marks.

MANUFACTURE OF SULPHURIC ACID BY CONTACT PROCESS. *Technical Records of Explosives Supply*, 1915-18. No. 5. Pp. 128. Ministry of Munitions and Department of Scientific and Industrial Research. (London: H.M. Stationery Office. 1921.) Price 26s.

POTASH. By S. J. JOHNSTONE. Pp. 122. *Imperial Institute Monographs on Mineral Resources, with Special Reference to the British Empire*. (London: John Murray. 1922.) Price 6s.

THE SWEDISH YEAR BOOK. 1921. Pp. 168. (Sweden: A.-B. Svenska Teknologföreningens Förlag, Stockholm; London: Williams and Norgate. 1921.) Price 7s. 6d.

PULVERISED COAL SYSTEMS IN AMERICA. By L. C. HARVEY. *Fuel Research Board, Special Report No. 1*. Pp. 117. Department of Scientific and Industrial Research. (London: H.M. Stationery Office. 1922.) Price 5s., post free 5s. 3d.

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THE CENTENARY OF PASTEUR.

STRASBOURG, MAY—OCTOBER, 1923.

In order to commemorate the centenary of the birth of Pasteur, the University and the town of Strasbourg, with the concurrence of the Pasteur Institute, and the approval of the family of Pasteur, have proposed to erect a statue facing the Strasbourg University where, as a professor, Pasteur commenced his career.

The inauguration ceremonies will take place on May 1, 1923, under the patronage of M. A. Millerand (President of the Republic), M. le Président A. Loubet, M. R. Poincaré, M. Leredu and M. Alapetite, and will include the unveiling of the statue, and the opening of an Exhibition of Hygiene and Bacteriology. The Exhibition will be designed to illustrate the advances made in various branches of science as the result of Pasteur's discoveries, and at the same time, a Congress of Hygiene and Bacteriology will be held for the discussion of questions relating to the prevention of disease.

With the object of showing the sympathy of this country with the projects of the French Committee, a British Committee composed of the following members has been formed:—Sir Charles Sherrington (chairman), Mr. A. Chaston Chapman (treasurer), Mr. H. E. Field (President of the Institute of Brewing), Prof. Percy F. Frankland, Sir John McFadyen (Principal of the Royal Veterinary College), Prof. C. J. Martin (Director of the Lister Institute), Sir W. J. Pope, Sir James Walker, and Sir Almuoth Wright.

Those who desire to contribute to the Memorial Fund are asked to send their contributions to the general secretary and treasurer, Monsieur Th. Héring, 6, rue des Vaux, Strasbourg, or to Mr. A. Chaston Chapman, The Institute of Chemistry, 30, Russell Square, London, W.C. 1.

The Commissioner-General, Professor Borrel, is very anxious to be furnished with the names of manufacturers and business firms in this country to whom the exhibition might be of especial interest. All who can assist are requested to communicate with Professor Borrel, 3, rue Koeberle, Strasbourg.

THE PRICE OF GERMAN SCIENTIFIC PUBLICATIONS.

Perhaps the most pressing problem connected with the present chaotic condition of trade is that of finding a method by which Germany can expiate her crime without damage to the industries of countries in receipt of reparation payments. Although it is not part of our function to discuss general economics, there is at least one aspect of this matter which falls within our scope. If the handing-over of commodities without payment causes damage to the trade of recipient countries, as we are frequently told—and in our own industry we know also what great damage our capital suffers through plant lying idle—the same cannot be said of the handing-over of knowledge and the results of experience in pure and applied science.

Speaking for the chemical industry, we say that it is imperative and urgent that advantage should be taken of every possible opportunity to achieve the latter object. One of the ways in which this may be done is to make German scientific and technical literature cheap and available to all workers in this country. Not only is this not being

done at the present time, but in spite of the rapidly falling exchange the cost of German scientific literature in this country is getting greater and greater. Prices are controlled by a powerful ring of German publishers, and the very high prices placed by them upon practically all scientific books for export could never have been extorted without the assistance of the German Government, which has allowed the Customs Officials to co-operate in preventing exportation. One's indignation is not lessened by the frank confession in the German Press that by charging these high prices abroad the publishers are able to keep the prices in Germany much lower than they would otherwise be.

We will take two examples to illustrate our point. Beilstein's "Handbuch der Organischen Chemie," Vol. IV., a work of some 730 pages, may be purchased from a bookseller in Germany for 412 marks, which we may take as equivalent to 6s. at the current rate of exchange. The price to English buyers has been raised to 110s., and the corresponding price is 380 francs in France and 22 dollars in America. As a second example, let us take a book on technical chemistry. "Die Zwischenprodukte der Teerfarbenfabrikation" is published in Germany at 210 marks, whereas the price for England is 80s. It will thus be seen that the Englishman is thought to be good to pay twenty times as much as the German, and it is alleged that we won the war!

The eve of the Genoa Conference is an appropriate moment to call attention to a matter which affects all scientific workers. We feel strongly that it is one in which the Governments concerned should take immediate action.

THE OXYGEN REQUIREMENTS OF THE YEAST CELL.

ARTHUR SLATOR.

In an article on Yeast Growth (*cf. J.*, 1919, 392 n) the retarding influences which limit the growth of yeast in malt wort were discussed. Emphasis was laid especially on the effect of alcohol, carbon dioxide, oxygen, and fermentable sugars. In a subsequent paper (*Chem. Soc. Trans.*, 1921, 119, 115) a description was given of some attempts to grow yeast under conditions arranged so that one factor only limits the growth and to compare the crop produced with the one which can be calculated from the constants of growth. When conditions were such that lack of fermentable sugar limited the amount of yeast produced, and when the carbon dioxide formed by fermentation was made the limiting factor, results were obtained which could be predicted theoretically.

Attempts to make oxygen the limiting factor were not successful. Large tubes containing small amounts of fermenting wort were exhausted by a water-pump and sealed. Abundant yeast growth was observed, and a definite relationship between seeding and crop was obtained. The conclusion was drawn that oxygen was unnecessary for yeast growth under these conditions. The matter is discussed in an interesting manner by L. Eynon (*cf. J.*, 1921, 187 n). It was found later that the method of investigation was not always reliable, for traces of air are apt to remain behind in the exhausted tube. The experiments were repeated in tubes which were first filled with carbon dioxide and then exhausted. Any trace of gas remaining in the tube was, therefore, carbon dioxide. Small seedings of yeast grew then

with difficulty, and many of the cells died. If traces of air were allowed to enter increased growth took place. The effect obtained was similar to that observed by Pasteur and measured by H. T. Brown. Anaerobic growth takes place to a limited extent in malt wort, and the addition of various substances (such as alcoholic extract of yeast) can increase this growth. Measurements of the logarithmic constant of growth are of considerable value in determining what the important factors are which control the growth of micro-organisms, and the author regrets the misleading results obtained in estimating the influence of oxygen on yeast growth. The experiments detailed in the above-mentioned paper are being repeated and extended.

THE ADMINISTRATION OF THE DYE-STUFFS ACT, 1920.

W. J. U. WOOLCOCK.

The Dyestuffs Act has now been in force during fourteen months, and the present time may be regarded as suitable for reviewing the administration of the Act and the results which have followed from this piece of experimental legislation.

The department responsible for its administration is the Board of Trade, and the Act itself set up two committees to advise the Board on matters connected with its administration. In practice the decisions of these committees have been accepted by the President of the Board of Trade, and there has been as little bureaucratic interference with the work of the committees as was possible in view of the responsibilities with which they were charged.

On the Advisory Licensing Committee has fallen the most difficult part of the work. It is composed of five representatives of the colour users, three representatives of the colour makers and three independent persons, one of whom is chairman. It is obvious, from the composition of the Committee, that neither the users nor the makers have an absolute majority; but the users only require to convince one of the three independent members that their case is sound to secure a majority, whereas the makers have to convince the whole of the three independent members before they can obtain a verdict in their favour. The consumers of dyestuffs in this country are therefore designedly in the majority on the Committee in order that nothing which the Committee may do shall prejudice the position of the consumers. In addition to the secretarial staff there are two technical advisers to the Committee who are particularly able men, one representing the users and one representing the makers.

The Committee has had before it over four thousand applications for licences, each application covering sometimes a number of dyestuffs and intermediates. The following table gives the completed figures for the year 1921 of the colours which have been licensed and refused:—

	Granted. lb.	Value. £	Refused. lb.	Value. £
Swiss	1,700,754	763,202	502,570	188,040
German	671,032	197,400	751,100	143,532
Other sources ..	209,719	82,056	265,648	36,797
Total foreign dyestuffs ..	2,677,505	1,042,821	1,539,336	368,378

There are two main reasons which an importer desiring the recommendation of a licence from the Committee may urge:—(1) That an equivalent British dyestuff is unobtainable in this country. (2) That it is only obtainable in this country at a price which is so much greater than that of the foreign dyestuff that it places the user in an unduly disadvantageous competitive position.

In the first case, the onus of proof that the British dyestuff is equivalent to the foreign is on the maker. In the latter case, the onus of proof that he is placed in an unduly disadvantageous position is on the user desiring to import.

The method of procedure is as follows:—The applicant for a licence furnishes the Committee with a description of the goods, index number (Schultz and Julius) if known, the quantity required and the price, and if it is required for stock, the quantity which he then has on hand. He is also required to state his reasons for making the application; such as, for example, whether he has tried an equivalent British dyestuff, and if so in what manner it fails to satisfy his requirements. These applications are first of all submitted to the technical advisers; if both technical advisers are satisfied that there is no suitable British equivalent a licence is granted forthwith, and there is no delay whatever. If, on the other hand, both technical advisers are satisfied that there is a British equivalent the licence is refused. The decisions of the technical advisers are subject to confirmation by the Licensing Committee. Where the technical advisers do not agree, or where through lack of information they do not agree to come to a decision, the applications come before the Committee. The main difficulty from which the Licensing Committee has suffered has been the failure on the part of applicants to furnish in the first instance sufficient evidence on which the Committee could come to a decision, and the lack of provision of laboratory accommodation in which the technical advisers can carry out independent tests as to the relative merits of British and foreign colours. These difficulties are gradually being overcome.

It is only natural that the administration of the Act should have called forth a considerable amount of criticism. It is impossible that legislation of this kind, designed to establish an essential industry in this country, should be received with enthusiasm by agents of foreign works, dealers in foreign dyestuffs, consumers who desire to make no change in their business arrangements, and politicians whose duty it is to oppose. But the constant stream of criticism, and, sometimes, misrepresentation, has left an impression in some quarters which it is difficult to dispel. The facts, however, clearly show that this impression is ill-founded. It is a fact, for example, that any consumer who requires a dyestuff which is not being made at the moment in this country can obtain it forthwith on application to the Licensing Committee. If evidence of this be required, the figures quoted above, which show that the quantity of foreign dyestuffs licensed is nearly twice as much as the quantity refused, should be sufficient. One of the principal difficulties which faces the Committee is that wherever possible the agents for the foreign dyestuff-firms naturally prefer that the application should not be made to the Committee by the consumer himself but by the agent. On the other hand, the onus of proof that a British dyestuff is equivalent to a foreign dyestuff is thrown on the dyemaker, and he is never likely to prove to the agent of a foreign dyestuff-firm that the British dyestuff is equivalent. Indeed, it is not necessary that he should. He must demonstrate it to the consumer, and for this purpose he has to be put in touch with the actual consumer. This is a source of grievance among the agents and dealers in dyestuffs. Their point of view is quite easily understood, and is one with which it is possible to have a great deal of personal sympathy. The Dyestuffs Act, however, was passed to establish the industry in this country, not to facilitate the business of agents and dealers in foreign dyestuffs. It may be rather unfortunate for them that the British maker is brought into contact with the British user, who has possibly been one of the agent's customers in the past, yet the consumers

through their Association insist that there is no other way in which the British dyemaker can demonstrate the equivalence of his dyes except to the actual consumer.

It has been mentioned above that the British dyestuff industry has to be established in this country without placing the textile and other colour-using industries in an unduly disadvantageous competitive position. Here the onus of proof is on the colour-using industry, and it must be admitted that it is even more difficult to prove this, than it is to convince a British consumer that a British dyestuff is equivalent to a foreign product. But in the same way as the accredited representatives of the dyemakers accepted the onus of proof as to quality, so the consumers accepted the onus of proof as to price.

This question of price is perhaps the most difficult problem before the Licensing Committee at the present time. The fundamental factor is the rate of exchange between this country and Germany, which makes it absolutely impossible for the British maker to meet foreign competition on an equal basis. On the other hand, textile manufacturers have to compete in the world's markets, and any reductions in price, whether in dyestuffs, heavy chemicals, labour, coal, raw materials, or overhead charges all help the British textile industry in competing with foreign countries. A perfectly logical case can be made out to prove that a reduction in all these items of cost would help to obtain orders. The trouble is that any stick is good enough to beat a dog with, and politicians and interested persons pick out the particular item in these various costs which suits their purpose and seek to make it appear the one factor which is preventing the textile industry from obtaining foreign orders. The temptation to take the short view, and purchase wherever dyestuffs can be obtained most cheaply at the moment, is prevalent in some quarters. What seems not to be generally recognised is that if the Dyestuffs Act were repealed, British dyestuff-makers would be compelled to close their works forthwith. This would be very serious from the point of view of national safety, although it might not be obvious instantly to the general public; but the first persons to suffer would be the very consumers of dyestuffs in this country who had allowed it to come about. With competition removed there would no longer be any reason why the foreign dyemaker should maintain his present prices, and the consumers in this country would ultimately have to pay for destroying the British competitor. Some people have difficulty in believing that anyone would be so unkind as to take advantage of the helplessness of this country, but there are two pointers which may be commended to any student of the subject. The one is the history of Alizarin production in this country, and the other is to be found in a comparison between the German price for dyestuffs not made in this country or in Switzerland, and the price of dyestuffs which are made either here or in Switzerland or perhaps in both countries. In these circumstances, although it may seem on a superficial examination that the position of the consumer of dyestuffs in this country is difficult at the moment, there can be no doubt that the consumer would be unwise to secure a temporary advantage at the cost of placing himself in the hands of the foreign dyestuff-manufacturers.

The position which the Licensing Committee has therefore taken up is to endeavour to get both makers and consumers to put forth a co-operative effort, even although it may entail business losses on both parties, to maintain the dyestuffs industry in this country in order that we may not throw away the substance in grasping the shadow.

The work of the Development Committee, which is the other committee provided in the Act, as will

be readily understood, could not commence until the work of the Licensing Committee had been advanced some way. The statistics which the Licensing Committee collect, as the result of its work, are the foundations on which the Development Committee has to build. The Development Committee has very carefully considered the details of the colours which have been admitted into this country last year, and as a result of its deliberations there were two lines of work open to the Committee to follow. It could either take as a basis the list of dyes not being made in this country, and endeavour to foster their production here; or it could take as its starting point the dyes which are at present being made in this country, some of them of not equal quality to the foreign dyes, and stimulate work on these dyes in order to bring them up to the standard of production to which the foreign dyes have reached. The Development Committee has very wisely chosen the latter course. At present there has been prepared a list of all the dyes which are being made in this country, together with their foreign equivalents. This list has been drawn up by the representatives of the dyemakers and will be placed in the hands of the dye-using representatives on the Committee. A good deal of evidence will have to be produced by the makers and investigated by the users before this list is complete, but when it is complete it will become a standard list of the dyes that are being efficiently produced in this country, and for which no licences to import foreign equivalents need be granted. When the British dyemakers have perfected the range of dyes which is being made at present, then it will be possible for the Committee to consider on what dyes, in order of their importance, development work should be started. At the present time research work is far ahead of production.

Such is a brief sketch of the administrative work under the Dyestuffs Act during the past year. A record of "something attempted, something done." Not as much nor as well done as those who have had the doing of it would desire, but presenting a record which even those who must deary find it difficult to assail.

THE SWISS CHEMICAL INDUSTRY AND THE MOVEMENTS FOR PROTECTION IN ALLIED COUNTRIES.

H. E. FIERZ.

The protective movements in England, America and France have, so far, not had the disastrous effect that was at first anticipated in Switzerland. It is true that the trenchant speeches of Mr. Francis P. Garvan and others have attracted much attention, but it is only just to say that his statements have produced more astonishment and entertainment than anything else. We are not poetical enough to be able to understand that radium and luminous watch dials should be the same, and Trotzky, Hugo Schweitzer and the simple girlish figure of Joan of Arc have no connexion in our mind with dyestuffs and pharmaceuticals. (Cf. Mr. Garvan's address to the American Chemical Society and the Society of Chemical Industry, Sept. 7, 1921, p. 15 of the reprint.) Nevertheless such opinions, however remarkable, have had a very distinct effect upon our leading men, and have helped to accelerate the change which was explained in this Journal last autumn (cf. J., 1921, 364 n).

It is very gratifying to be able to report that much progress has been made in the quality of dyes produced in Switzerland, and it is safe to say that by now the Basle dyeworks can produce all the intermediates which they used to buy before the war from Germany and England, and of a quality equal to pre-war standards. Practically all the dyestuffs are now again being made in excellent strength, and prices are tending to reach the level of 1913.

It is true that the statistical aspect of affairs does not make a very favourable impression, but it must be borne in mind that prices in 1920 were very high; the stagnation which followed the boom must not be taken too tragically.

In the year 1920 colouring matters to the value of over £8,000,000 were exported from Switzerland, against a value of £5,400,000 in 1919. The imports were trifling (4 million francs). In the first nine months of 1921 the exported value was only £1,500,000, or almost exactly the value exported in 1913. This decrease was not due to German dumping, but to the bad state of trade generally, for the imports of dyestuffs fell to the very small value of 2.5 million francs (say, £114,000).

It is important to note that Swiss dyestuffs have attained the pre-war level both in quality and variety. This astonishing result has been achieved by very hard work, and because the leading men have realised that the staff of chemists was too small. Probably to-day the research chemists number about 150, as compared with, perhaps, 80 in 1914. We do not know the so-called "chemical engineer" in Switzerland, because all our chemists in Basle have undergone a real university training, and have, with trifling exceptions, got their D.Sc. or Ph.D. degree.

The excellent staffs have not been reduced at all during the bad period. Not a single man has been discharged, a fact which compares very favourably with what has happened in certain branches of chemical industry in other countries. The good results mentioned above, viz., the high quality of the intermediates and finished products, are due to this cause.

Although production has decreased as compared with 1920, the output of high-class products has greatly increased. The Ciba Co. has brought out a whole range of direct colours fast to light, Sandoz a series corresponding to the Bayer alizarin-acid colours, and Geigy is able to offer all its well-known standard dyes (Erio Chrom Black T, Erio Chrom Azuro, etc.). This explains why exports are now gradually increasing, a fact which is all the more noteworthy because at present wages in Switzerland are very high, and Swiss currency commands the highest premium in the world (gold is circulating freely and offered for paper at the banks). At the same time Swiss works have changed to a certain extent their field of activity. Ciba has started a photographic department which is making good progress, and Sandoz, under the direction of Professor Stoll, has obtained excellent results in the pharmaceutical field. But smaller undertakings, e.g., the Flora Dübendorf Co., are also offering very good photographic chemicals, and Hoffmann-Laroche is extending its drug department.

Although the present slump in trade is severe, it has not affected certain branches of industry in Switzerland as much as it has those of other countries. Basle is working now at full pressure during 5 days of the week, and its English extension seems to be the only firm in England which occasionally works overtime. But the branch at Cincinnati is also getting on fairly well, and the outlook in America is more promising.

The very strong agitation in certain circles against the importation of chemicals into America and England has forced the Swiss undertakings to try to find new fields. It is a mistake to think that

chemical works can be starved simply because the door is locked. India and the Far East are demanding our products, and it is found that we can undersell any competitor except Germany, in spite of the high value of Swiss currency. I have convinced myself through actual offers that Swiss prices are, as a rule, 30–50 per cent. under the quotations of the Allied countries, and only about 5 per cent. above the German prices.

It now remains to be seen whether the said restrictions will be maintained indefinitely, a possibility which seems to be rather unlikely. Those who promote such restrictions overlook the fact that trade is reciprocal: one-sided policy will always ruin those who try to enforce it. The United States is feeling the economic law very badly, and it will never become the manufacturer for Europe if it decides to sell and not to buy. We can only buy from those who buy from us, in spite of Mr. Francis Garvan.

Whilst the outlook for dyestuffs and allied chemicals seems hopeful, the other branches are suffering very much. The export of carbide, which was 80,000 tons in 1917, has practically stopped because Germany, our best customer, is unable to buy from us, and the possibility of recovery appears very remote because the German exchange is declining *pari passu* with the payment of the war indemnity. Germany is producing at present over 570,000 tons of carbide annually from coal-power because our water-power is at least twice as dear. Only one acetylene-product, namely, metaldehyde, appears to have a promising future. The new Meta Co., an offshoot of the Lonza Co., is selling it in fair quantities, and it is anticipated that this clean, combustible solid will replace liquid fuel for certain special purposes. In addition to metaldehyde a certain quantity of acetic acid is being produced in Viège, but the production of alcohol has proved to be impossible on account of market conditions. Aluminium and carborundum are very dull, but some of the former is being exported to Germany where the demand greatly exceeds the supply.

Another branch which was developing very well, viz., the manufacture of high-grade nitric acid and 98 per cent. sodium nitrite has been interrupted by a serious accident. The Nitrum works in Bodio had the advantage of exceptionally cheap electric current, costing under 0.1d. per kw.-hr., and its products were in good demand. The Bodio process, a modification of the Ph. Guye process, consisted in freezing out the nitrogen peroxide formed in the electric arc. This was effected by cooling the gases in aluminium tubes with liquid ethane, which was cooled to -78° C. with light petroleum. By an accident (leakage of a tube) a large quantity of nitrogen peroxide became mixed with petroleum. As the river Tessin was practically dry, it was impossible to discharge the dangerous mixture into the water, as had been done before in Rhyna (on the Rhine). It was attempted to separate the mixture by careful distillation at a low temperature. This was proceeding quite successfully and a large quantity had already been recovered safely when the weather became very hot, the thermometer rising to 50° C. in the narrow valley. The vessels containing the bulk of the mixture (which was being distilled in another room) got too hot, detonated, and the works were reduced to powder. Seventeen men lost their lives, including a personal friend of the writer, Dr. Belser, one of our best chemists.

I have said that the economic stagnation has had a marked effect upon our chemical trade, home and foreign. It has also had another and very remarkable effect. Owing to the depression many of the new chemical undertakings have had to close down, and it has become rather difficult for chemists to find satisfactory appointments. On account of this fact the number of our chemistry students has

already decreased by over 55 per cent., but it is satisfactory to report that the quality of the newcomers is greatly improving. No longer can a youngster obtain an initial salary of £400 a year simply because he can say H_2O ; and those who do not like chemistry are trying other things. A certain number of our graduates are finding satisfactory posts with petroleum companies, some go to Germany, and others are waiting.

I hope my next report will contain news of further improvement, but it is evident that normal conditions will not be restored for many years to come.

THE SAFEGUARDING OF INDUSTRIES ACT.

CREAM OF TARTAR, TARTARIC ACID, CITRIC ACID.

The complaint that the above-mentioned substances were improperly included by the Board of Trade in the lists of articles subject to import duty under Part I. of the Act was heard by the Official Referee, Mr. Cyril Atkinson, K.C., at nine sittings held in February and March, the awards being delivered on March 18.

Sir Arthur Colefax, K.C., and Mr. K. Swan appeared for the complainants, whose names were not disclosed. Sir Duncan Kerly, K.C., and Mr. Courtney Terrell represented the opponents; Messrs. Kemball, Bishop and Co., Ltd., the Phoenix Chemical Co., Ltd., and Messrs. Howards and Sons (citric acid only). Mr. Whitbread appeared for the Board of Trade. The inquiry centred around the problem whether the three substances were fine chemicals or not, and at the first sitting the Referee notified that he proposed to adopt the following procedure:—(1) To ascertain as many relevant facts as possible; (2) to find out if the term "fine chemical" had a well-understood commercial meaning; and (3) if so, what was it? if not, (4) to ascertain if the substances were generally regarded as fine chemicals in the trade; only in the event of failure to establish one or other of these points would he take into consideration the purpose of the Act, as defined in its preamble.

During the hearing of the evidence it soon became apparent that the three substances constituted border-line cases; there were admittedly heavy chemicals and admittedly fine chemicals, but the two groups overlapped and there was also an intermediate zone. Various attempts were made to define the term "fine chemical" with the object of expressing in precise language the vague concepts which had floated in the minds of traders and manufacturers prior to the passing of the Act. These definitions brought into light the following criteria, which, in the main, were admitted by both sides:—

A fine chemical:

(a) is produced by skilled labour under the close supervision of skilled chemists, and the cost of such skilled labour and supervision is high in comparison with that of the unskilled labour employed;

(b) has a high degree of purity (dilutents neglected);

(c) is normally produced in relatively small quantities and made in small batches;

(d) is made, as a rule, in plant which is not highly specialised and can therefore be used for other purposes (Dr. Ormandy);

(e) has usually a high price; and

(f) has relatively few uses.

(a) The nature and amount of the skill required in manufacture appeared to be generally regarded, if not as the determining, as a very important criterion, and many questions were put to manufacturers to throw light upon this point.

(b) Although high purity is a characteristic of a fine chemical, it was agreed that some heavy chemicals, *e.g.*, sodium bicarbonate and Epsom salts, are also marketed in a very pure state.

(c) The consumption of these substances is much greater than that of most, if not all, admittedly fine chemicals (3000–3500 t. of cream of tartar is consumed annually in the U.K., compared with 500–700 t. of quinine sulphate), but it is very much smaller than the consumption of such typically heavy chemicals as bleaching powder (109,000 t.), sulphuric acid (200,000 t.), ammonium sulphate (264,000 t.), sodium bicarbonate (178,000 t.) and superphosphate (605,000 t.).

Evidence was given concerning the manufacture of these substances in France, England, Germany, Italy and Spain. In France, Italy and Spain large quantities of cream of tartar have been made mainly from selected raw materials ("vinaccias," "limos" and "argols") by the St. Thibery process, which witnesses for the complainants stated consisted essentially in solution, crystallisation, and decolorisation, and required no skilled chemical supervision. The simple titration-tests were stated to have been performed by youths, acting under a foreman, trained in the works; the raw materials to have been purchased on the seller's analysis; and the final products to have been analysed and sold in London. M. Gladysz, of Mante et Cie, Marseille, said that his firm owned two factories, a large one using the St. Thibery process at Agde, near Montpellier, which had a daily output capacity of about 8 tons of cream of tartar, but which had been closed down for some time, and a smaller works at Marseille, with a capacity of about 4.5 t., which used a "secret" precipitation process introduced after the war, and had continued to operate. Whereas the former works employed no chemists, the latter had two, who were engaged in research work and were not allowed to enter the factory. The product made at Agde was asserted to have been invariably of pharmacopoeial purity, the presence of lead, copper, iron and arsenic having been avoided by the use of wooden or earthenware vats, and the percentage of potassium hydrogen tartrate extracted from the raw material was given as 92–94. The same firm had a daily output capacity of about 5 t. of tartaric acid and 3 t. of citric acid.

Mr. A. M. Peake said that for over 2 years he had been chief laboratory and control chemist at the Mante works in Marseille, where all three substances were manufactured, the cream of tartar by a modification of the process patented by T. Gladysz in 1899 (Eng. Pat. 22,117, *cf.* J., 1900, 1142). In his opinion this process required expert chemical supervision. The St. Thibery process, he was convinced, could not yield continuously a product of 99 per cent. purity; it also required skilled chemical control; it was practically obsolete; he had tried it in a works in South America, but had abandoned it as unsatisfactory. In Italy all three substances were made under skilled chemical supervision.

Mr. E. Bernal, managing director of P. L. Vernier et Cie, Montpellier, stated that his firm had a daily output of 1.5 t. of cream of tartar, which was produced from high-grade argols by a simple process of solution, crystallisation, and decolorisation with animal charcoal. The product was analysed in London, contained 99.2 per cent. or more of the bitartrate, 0.0009–0.0020 per cent. of lead, and no arsenic. No skilled chemists were

employed and the simple titration-tests were done by boys.

Messrs. H. Ballantyne, C. A. Hill, J. Swinburne and J. E. Whitehall gave evidence concerning the manufacture of cream of tartar and of tartaric acid at the two factories of Messrs. Kemball, Bishop and Co., Ltd., to the effect that the processes of manufacture there conducted required direct chemical control in addition to that exercised in the analytical laboratory. Mr. Whitehall, managing director, said that owing to the trade depression 412 workers only were now employed at the two factories, and these included 10 professional chemists (four of whom were on process work) and 5 apprentices, and 16 specially skilled men. The output of tartaric acid was distributed approximately as follows:—Wholesale druggists and "saline" manufacturers, 61%; for baking-powder, 22%; confectioners, 4%; export, 2%, and a little to the textile industry. Details of the plant and processes used by this firm were disclosed *in camera*.

Mr. J. R. Lankshear, of Messrs. Lankshear, Wickstead and Co., Ltd., near Stockport, described in considerable detail his firm's method of manufacturing tartaric acid from comparatively low-grade argols (50–60%) by the Scheele-Lowitz process, as modified by Desfosses. There were many and constantly recurring difficulties in the manufacture which could only be overcome by most careful expert supervision in addition to analytical control; the yield at every stage was of the greatest importance from the financial point of view. Among other difficulties, that of filtering the calcium-sulphate sludge, especially if it were produced from a low-grade raw material, was very great, and temperature and concentration were considerations of utmost importance. He employed a chief chemist and five chemical assistants, and one chemist was always on duty. The process could not be conducted satisfactorily by a skilled foreman and a qualified chemist exercising a wide supervision. He had manufactured cream of tartar on an experimental scale by the St. Thibery process with unsatisfactory results; it was a "hit or miss" process.

Lt.-Col. Kemball stated that he had visited Germany in 1919 with the mission sent out by the Board of Trade and had inspected three factories where cream of tartar, tartaric acid and citric acid were made. The plant he had seen was not for making cream of tartar by the St. Thibery process but for producing it by a process which involved the intermediate production of Rochelle salt. Chemists were employed both for process and laboratory work.

A Spanish manufacturer said he had produced, before his works were closed down, 2 tons per day of cream of tartar by a process involving only filtration, crystallisation, and decolorisation; he employed no chemists and he used high-grade raw material.

Counsel for complainants called a number of chemical dealers who stated that they had always regarded cream of tartar, tartaric and citric acids as heavy chemicals, although they were unable to draw any sharp line between "fine" and "heavy." Dealers' catalogues and price-lists were produced in which the substances were classified as "technical" or "industrial" chemicals, which some witnesses held to be synonymous with "heavy," and sometimes as "pharmaceutical" chemicals, the great bulk of which was admitted to consist of fine chemicals. In these lists it was not uncommon for the same substance to appear under two or more headings, and, in general, it appeared that the classification was determined to a great extent by the class of buyers to which the list was sent. Only one dealer was called by the opponents to give evidence in the contrary sense, but a number of manufacturers, including Mr. C. A. Hill and Mr.

T. D. Morson, were very emphatic in their testimony that the substances in question had always been regarded as fine chemicals.

References in the trade journals appeared, in the main, to be indirect and inconclusive, and tended to corroborate the evidence of many witnesses that prior to the passing of the Act but very little thought had been given either to the exact classification into "fine" and "heavy" or to the precise meanings of these terms. On the other hand, stress was laid upon the fact that in the *Journal of the Society of Chemical Industry*, from 1882 to 1909, most of the abstracts concerning the substances had appeared under a heading which left no doubt that the Publication Committee at that time had regarded them as fine chemicals, and that since 1916 the Association of British Chemical Manufacturers had classified makers of these products as fine-chemical manufacturers.

The following is the verbatim text of the award, as signed by the Referee, on March 25:—

In this case the complaint is that cream of tartar, tartaric acid, and citric acid have been improperly included in the Board of Trade list. They have been included in the list as fine chemicals. The question for me is whether the complainants have established that such inclusion is improper. There is no scientific meaning of the expression "fine chemical." It is a trade term. That is common ground. The complainants say that there is no trade definition of the term, that it is incapable of definition, and that I must find out what the custom of the trade has been regarding the classification of the substances in question. The respondents say there is a definition, and that, judged by the definition, these substances are fine chemicals. Therefore the first question I must ask myself is whether the term as used in the trade has a meaning definable in language that will yield a reasonably definite test for the determination of the question before me. A number of trade witnesses was called to give evidence as to the usage with regard to these particular chemicals. In their view the word "heavy" is synonymous with "industrial." A heavy chemical is one which is sold mainly for industrial or technical purposes. They say that the word "fine" is used in contradistinction to "heavy," but beyond this they are not prepared to say what the expression "fine chemical" means. They are supported by classifications appearing in trade lists, and particularly by Merck's catalogue, where fine chemicals for the materia medica and the arts and fine chemicals for the laboratory are contrasted with chemicals for industrial purposes. Dr. Fox told me in the Santonin case that a heavy chemical was a commercial product produced on a large scale, and that the term "fine chemical" was generally used in contradistinction to heavy chemical. Mr. Carr said that in the trade "heavy chemical" was generally taken as relating to chemicals which were handled in large quantities or which were of limited purity. He said that, with very limited exceptions, that which was not heavy was fine. Mr. Ronca said that generally in the trade you found the expression "fine chemical" used to cover those chemicals which were not heavy. Mr. Lankshear said that a fine chemical was one usually produced in a high state of purity, the economical manufacture of which involved continued scientific control and supervision. Mr. Swinburne said that a fine chemical was one made with considerable difficulty, involving a good deal of skilled supervision, scientifically pure, and made in comparatively small quantities. Mr. Ballantyne's definition is as follows: "A fine chemical is a refined chemical of purity such as one associates with pharmaceutical chemicals, which is normally manufactured in relatively small batches, prepared under highly

skilled supervision and with skilled labour, the manufacture being constantly controlled and conducted by such supervision and labour and the cost of such supervision and labour being high in proportion to that of the unskilled labour employed." It will be observed that these last three definitions agree in this that they contain no reference to the use to which a chemical is put. Dr. Ormandy introduced into his definition considerations of the nature of the plant and the use of the product. Mr. Ballantyne further said that heavy and fine were not used in antithesis the one to the other; that a chemical might be both heavy or fine or neither; that classifying chemicals as heavy and fine was like dividing people into those with big hands and those with red hair. Mr. Hill in his paper "What is a Fine Chemical?" says "The first classification of chemicals is into heavy and fine."* Hence to the question, "When is a chemical a fine chemical?" we may reply "When it is not a heavy one."

How can one reconcile these conflicting views? All the expert witnesses, except Mr. Hill, admit that until now they have given no thought to the meaning of the expression. They have never used it. They have picked out certain characteristics of typical fine chemicals and strung them into the form of a definition. I have no doubt that everything they say is descriptive of many fine chemicals, but it is quite clear that there exists nothing in the nature of a commonly accepted definition or even of a commonly accepted description of a fine chemical. Dr. Ormandy says quite frankly that they are trying to define something which is indefinable, and that he and everyone else have failed. He finds no very clear basis for the trade classification, and says that he is trying to invent one. Mr. Hill wrote that the conception of what is a fine chemical was definite though indefinable. I am satisfied that it is indefinable, but having heard so many different descriptions of the term I doubt very much whether the general conception is as definite as he thought when he wrote those words. So far as I can see no two persons have the same conception of the term.

The search for a definition having failed, I turn to the question of trade usage. On the balance of evidence, including that contained in Mr. Hill's paper, I come to the conclusion that the terms "heavy" and "fine" have been used in antithesis to one another in this sense that, though there may be, and probably are, some chemicals which do not fall into either class, if a chemical has been classified, or ought to be classified, as heavy it is not fine. I am satisfied on the evidence that the trade has not regarded these three substances as fine chemicals. The trade evidence called by the complainants is almost uncontradicted. I think that the trade regarded heavy chemicals as commercial products mainly used for industrial purposes, and that they so regarded cream of tartar, tartaric acid, and citric acid. On this point I accept the evidence of the trade witnesses for the complainants. Their evidence was supported by a number of lists and catalogues, and by many references to trade journals, and by references to Board of Trade reports, in which these substances were treated as heavy chemicals.

The evidence from the journals was not by any means all one way. The *Journal of the Society of Chemical Industry* generally treated the substances we are discussing as fine chemicals down to the year 1909, but it is significant that (for some reason which has not been explained) the *Journal* placed them under the group-heading Acids, Alkalis, etc. and ceased to refer to them under the

fine-chemical group, the heading of which became "Organic Products, Medicinal Substances, Essential Oils." *The Chemist and Druggist*, although on many occasions speaking of these substances as heavy chemicals, frequently refers to them as pharmaceutical chemicals or as drugs, and sometimes refers to them in contradistinction to heavy chemicals. I do not attach importance to the inclusion of these substances in lists of pharmaceutical chemicals inasmuch as they have a use in pharmacy, and whether heavy or fine are properly placed in such lists. However, weighing up all the evidence, I am satisfied, and find as a fact that, so far as trade usage is concerned, the complainants have proved that not one of these three substances has been commonly regarded as a fine chemical. According to Mr. Ballantyne and the secretary of the Society of Chemical Industry, that finding ought to settle the question. I think it does, but I propose to consider how far this trade usage is justified as judged by the evidence of the expert witnesses, who I am sure have all done their best to help me.

I am satisfied that the main use of these three substances is industrial or commercial, although there is a very substantial use of tartaric acid for saline preparations such as Eno's Salts. Mr. Lankshear agreed that they were commercial products produced on a large scale, thus bringing them within Dr. Fox's definition of a heavy chemical. I think he is right. I have read and re-read two of Mr. Hill's papers, the 1916 paper and the one to which I have already referred. I attach the very greatest weight to them, particularly to the former. It was written before men's views were influenced by the passing of this Act, and was, so far as I know, the first attempt to deal with and explain the difference between heavy and fine chemicals. The second paragraph in the 1916 paper deals with the distinction between heavy and fine chemicals. With one trifling exception Mr. Hill agrees that not a word of the description of a fine chemical there given applies to any one of the three substances with which I am concerned. In 1916 it was clearly his opinion that the use to which the chemical was put was relevant. He pointed out the difficulty created when the same substance was used for both technical and medicinal purposes. I think the 1916 paper supports and justifies the trade classification of these substances. In my opinion, if judged by that paper, these substances are not fine chemicals. This paper was shortly followed by a grouping of chemical industries by the Association of British Chemical Manufacturers. Group VI. is the fine-chemical group. Its description is as follows: "Analytical, pharmaceutical, photographic, rare earth, synthetic essences and perfumes, alcohol derivatives, ethers." The grouping, except in so far as specifically indicated, does not cover chemicals properly described as industrial, that is, chemicals mainly used for industrial purposes. I do not think that a chemical primarily and mainly industrial can properly be described or classified as a pharmaceutical chemical merely because it has some use in pharmacy.

The main ground upon which the respondents rely is the difficulty of manufacture, the necessity for highly skilled chemical supervision and labour constantly controlling and conducting such manufacture. I have tried to visualise the skill required in the factory of a typical fine-chemical manufacturer. In practice I gather a fine-chemical maker makes a great many different chemicals. Mr. Morson's firm makes between two and three thousand different chemicals in a year. It seems to me that the knowledge and skill required in

* "Present Position of the Fine Chemical Industry." C. A. Hill. J.S.C.I., Dec. 31, 1920, 425R.

† "What is a 'Fine Chemical'?" C. A. Hill. J.S.C.I., Nov. 30, 1921, 419R.

‡ "The Manufacture of Fine Chemicals in relation to British Chemical Industry." By C. A. Hill and T. D. Morson. J.S.C.I., July 31, 1916, 792.

such a factory, both from the chemists and from the workpeople, must be of the most varied kind, and totally different from the knowledge and skill required for the continuous production of one or two particular substances, such as those with which I am concerned in this case, which may be acquired simply by working at the particular operations involved. Mr. Ballantyne agrees that all that is wanted in the production of these substances is skill *ad hoc*, and he agrees that even a higher degree of skill is required for the production of many admittedly heavy chemicals. How, then, does the degree of skill requisite help me to settle this question? I think that the difference between the skill and learning required for fine chemical production and that required for heavy chemical production rests in this, that for the former a wide and varied knowledge of the highest kind is requisite, whilst for the latter a knowledge limited to the production of the particular chemical is sufficient. Doubtless the same kind of skill and knowledge would be sufficient for the production of many fine chemicals considered separately and individually, but fine chemicals are not produced in that way. I think that the high degree of skill and knowledge to which the witnesses point as associated with fine-chemical work is due to the fact that fine chemicals are produced in great numbers in the same factory, and that the persons there employed must be able to produce very many such substances, and must therefore have a very wide degree of chemical knowledge.

In substance I accept the evidence of the witnesses from France and Spain, although I am quite ready to believe that they have minimised their difficulties. But after discounting in that respect what they told me, I am satisfied that the skill demanded in their factories of those responsible for supervision, and of the workpeople, is of a different class from that required for fine-chemical production. The trade committed itself to its classification of cream of tartar, etc. at a time when the methods of production described by the witnesses were general, or at any rate were more general than they are now, and when the production here was very limited. There is no evidence that the methods they described are not those generally adopted in France, Italy and Spain. I think that the system of production as described by those witnesses must be a commercial system, and that there is no real foundation for the scepticism of some of the witnesses as to the results achieved. One has only to look at the figures relating to the imports to see how impossible it is to say that the method of production as carried on in France and Spain is a "hit or miss" method and not a practical commercial method. There is no doubt that the process as carried on by the three English manufacturers is much more difficult, but, according to Mr. Ballantyne, it is no more difficult than that required for, at any rate, some heavy chemicals, and the skill required is certainly not of that varied character demanded by typical fine-chemical manufacture.

Again, the measure of production is said to afford a test. If it is so it is conceded that no fine chemical is produced in the same quantities as cream of tartar and tartaric acid. I am, therefore, unable to say that as judged by the tests suggested by the respondents it has been proved that the trade usage with regard to these chemicals is wrong, or unreasonable, or so wrong or so unreasonable that it ought to be rejected.

I want to apply one more test. In my opinion the object of the Act is to protect certain key industries, and I am sure that the fine-chemical industry, that is, the industry carried on by fine-chemical manufacturers, is one of the industries to

be protected. I think that the paragraph in the schedule dealing with chemicals is intended to be a description of the fine-chemical industry. Now, I was rather struck by a suggested definition of a fine chemical in one of Mr. Hill's papers, namely, "Fine chemicals are chemicals which are made by fine-chemical manufacturers." He says that the definition is not so ridiculous as it would seem at first sight. I think it contains an idea which is very helpful. Are these substances made by fine-chemical manufacturers? The only firms spoken of as making any of these substances are the respondents, the Phoenix Chemical Co., and Kembell, Bishop and Co., and Lankshear, Wickstead and Co. In the official directory of the Association of British Chemical Manufacturers published in 1919 not one of these firms appears under the heading of makers of fine chemicals, or under the heading of makers of pharmaceutical chemicals, although they do appear as makers of cream of tartar and tartaric acid. The same thing appears in Kelly's chemical directory. In the "Who's Who" of the Association of British Chemical Manufacturers for the year 1919 only the Phoenix Chemical Co. appears in Group VI. Kembell, Bishop and Co. and Lankshear, Wickstead and Co. do not appear in Group VI. until 1921. Nor are these firms, any more than the French and Spanish firms whose factories have been described, fine-chemical manufacturers in the sense in which Mr. Morson's firm are fine-chemical manufacturers, nor in the sense in which that expression is generally used. The industry intended to be protected is, I think, that of the typical fine-chemical manufacturer, an industry calling for the highest and widest skill both from its supervisors and its workpeople. There is no evidence before me that any of these substances are manufactured by any fine-chemical manufacturer. In my opinion, in the absence of a scientific or a trade definition I have to be guided by the trade classification, if there has been one. I am satisfied that trade usage has not commonly classified these substances as fine chemicals. I am satisfied that the persons who make them have not called themselves or considered themselves fine-chemical manufacturers until quite recently. I am not satisfied that, judged by any of the tests suggested by the expert witnesses, these substances ought to be classified as fine chemicals. I, therefore, direct that they be excluded from the Act.

After reading his award on March 18, Mr. Atkinson agreed to hold it up for one week to enable the Board of Trade to decide if it wished to ask him to state a case upon a question of law. In reply to a question, he said that there were two propositions in his award by which he would consider himself bound in future cases:—

(1) The finding of fact that there is no commonly accepted definition of a fine chemical (he would hear no further evidence on the meaning of the term, unless it were of an entirely different kind).

(2) The main test is trade classification or usage. The only point of law that emerged appeared to be if he was right in saying that if there was no trade definition, he would be guided by trade usage, if there had been a definite trade usage.

On March 25 the Board of Trade intimated that it did not propose to ask for a case to be stated. On the other hand, Mr. C. Terrell, on behalf of the respondent firms, asked for a case to be stated on one or more points, including that mentioned above, but after discussion the Referee refused the request, adding that it would be open to them to move that the award be set aside. He also stated that he would not again allow any party other than complainants or the Board of Trade to ask for a case to be stated.

LACTOSE "R."

The application to remove Lactose "R" from the list, preferred by Messrs. Allen and Hanburys, Ltd., and opposed by the Board of Trade, was heard on March 4, and the decision given on March 18.

Refined lactose, according to the Board, is a chemical because it has a constant molecular composition, is a "prepared" article, is used generally and primarily on account of its chemical properties, as distinct from its physical properties; and it is a fine chemical because its preparation involves skilled chemical and bacteriological supervision, because it is produced in typically "fine-chemical" plant, is very pure, and is prepared and handled in comparatively small batches. The annual consumption in this country is about 400 tons, compared with 2 million t. of cane sugar. The fact that it is used as a food does not preclude it from being a chemical, and even its value as a food is dependent upon the chemical change (oxidation) it undergoes in the body.

The case for the complainants was, briefly, that purified lactose is neither a chemical nor a fine chemical, because it is obtained from whey by extraction, no chemical changes being involved and no expert chemical skill required. It is essentially a foodstuff, like cane sugar or starch. It is nowhere referred to in the literature or in price-lists as a fine chemical. Its purity is that of a fine chemical, but the quantities in which it is handled approximate to those of heavy chemicals.

Mr. F. W. Gamble, a director of Allen and Hanburys, Ltd., said that his company used about 250 tons per annum of purified lactose, mostly in the preparation of infants' food, and that it was mainly obtained from Holland and the United States; it was used to a small extent in compounding drugs and as a bacteriological medium. Lactose was a well-defined chemical compound; it was chemically reactive and underwent oxidation in the body. He would not call it a pharmaceutical chemical, but a pharmaceutical preparation.

Mr. E. J. Parry expressed the opinion that lactose was a chemical compound but not a chemical in the trade sense, because it was not used for any purpose for which a chemical was used, it was not prepared by a chemical process, and it was a foodstuff and only a foodstuff.

Mr. C. M. Dhont described the process of extracting lactose from whey as carried out by his company (N.V. Hollandse Melksuikerfabriek) in factories situated in Amsterdam and in the north of France. These factories employed 60 and 35 workers, respectively, and at each there were two analytical chemists, one being also works manager. The chemists determined the sugar-content of the whey with the polarimeter, and also the ash-content. The necessary titration-tests for lactic acid were performed by ordinary workmen acting under the supervision of a foreman. After skimming the fat, the whey was heated with lime or other alkali in steam-jacketed copper vessels of 650 galls. capacity, and a second treatment to precipitate albuminoids was not necessary. Following filtration, the liquid was evaporated and crystallised to yield crude lactose. This was centrifuged, re-dissolved, filtered, and crystallised. Further crystallisation was unnecessary.

Mr. J. C. Stead said he was in charge of a small factory built by the Ministry of Agriculture to produce lactose from whey. Previously he had been manufacturing fine chemicals for ten years. He described the process used and the various analytical tests which were applied. Eight unskilled workers were employed, but in his opinion expert chemical control—particularly to interpret the results of the

tests—was essential to a greater degree than in the manufacture of many fine chemicals. The plant could deal with 3,000 galls. of whey per day, but so far only 2,000 galls had been treated. Similar evidence was given by Mr. C. D. Whetham, F.R.S., who has been experimenting with a view to erecting a lactose factory on his own farm. He did not use a titration test to determine acidity, but a new and improved method. He had found it necessary to carry out the coagulation of the albumin in two stages, to adjust the hydrogen-ion concentration with great accuracy, and to recrystallise at the end of the operations. Mr. Siebold, chemist to the Lactose Milk Sugar Co., whose works at Tipperary, Ireland, are now closed, gave corroborative evidence.

The Referee's award was as follows:—

The complaint in this case is that lactose has been improperly included in the Board of Trade list. It has been included in the pure form as a fine chemical. It is said by the complainants that lactose is not a chemical, and if it is a chemical, that it is not a fine chemical. The word "chemical" has no scientific meaning. It is not a word used by scientific persons. They speak of chemical compounds. There is no warranty for saying that the word "chemical" as used by ordinary persons is synonymous with the expression "chemical compound" as used by scientific persons. I do not believe that ordinary persons use the word "chemical" in a sense so wide as to cover substances such as water, starch, and sugar, though doubtless all these substances are chemical compounds. My present feeling is that the word "chemical" as used in this Act was not intended to cover food substances. Under section 2, where words wide enough to cover foods are used, foodstuffs are expressly excepted. But I need not come to any definite decision about that as I am satisfied even if lactose is a chemical it is not a fine chemical. I need not repeat what I have said in the last case. I have only to apply the tests suggested. There is not a particle of evidence that the chemical trade has ever classified or regarded lactose as a fine chemical. Judged by Mr. Hill's 1916 paper, lactose is not a fine chemical. Applying the definition of a fine chemical as "made by fine-chemical manufacturers," there is, of course, only one result possible. So far from being made by fine-chemical manufacturers, lactose is made by persons who do not call themselves even chemical manufacturers. Mr. Dhont's firm is known as the Milk Sugar Works, of Amsterdam. The firm in the United States from which the complainants buy is known as Sheffield Farms. Mr. Siebold's company is known as the Milk Sugar Company. I do not believe that any one of these firms ever thought of themselves as fine-chemical manufacturers. The main ground urged as justifying the inclusion of lactose in the list is the difficulty of manufacture. I accept the evidence of Mr. Dhont. His firm turns out 600 tons a year without any chemical supervision of the process at all. There is a works manager who is a sugar chemist, and another chemist is employed for the purpose of analysis, but Mr. Dhont assured me most positively that the only supervision of the process is that of the foreman. Mr. Stead, with his eight untrained hands, has doubtless to do a great deal himself. Mr. Whetham has been merely experimenting. Mr. Siebold dwelt on his many difficulties, but all of them attend the production of the crude article to just the same extent as the production of the fine article. In my opinion there is no evidence at all which brings the manufacture of lactose within any one of the definitions or descriptions of fine chemicals yet suggested. The logical result of the inclusion of lactose would be startling. If lactose is properly

included, what about cane sugar? It is just as much a chemical, it is just as pure, and it is more difficult to produce. The only difference is that it is produced in greater quantities. It is difficult to see how it can be seriously urged that the inclusion or exclusion of a substance in or from the list has to depend upon the quantity of the substance produced. In my opinion lactose is not a fine chemical, nor has it been regarded by the trade as a fine chemical. I think that it should be excluded from the list.

DEFINITIONS BY THE OTTAWA SECTION.

At a meeting held on February 14 the Ottawa Section of this Society discussed the definitions of certain debatable terms occurring in the Act which had been put forward by a committee appointed for the purpose. Only one or two minor changes were introduced, and the definitions as adopted are given below. A definition of "fine chemical" was not framed, as it was held that no sharp distinction could be drawn between "fine" and "ordinary" commercial chemicals. Further, it was held desirable to frame the definitions upon scientific lines and that exceptions, if any, should be specifically mentioned in any enactment. The word "synthetic" was taken in its literal meaning and not in the sense of "artificial."

"Manufactured."—The term "manufactured" shall be defined as:—That which has been made, formed, fabricated, or produced in industry and/or the arts, by the application of physical, mechanical, chemical or manual means or processes, or by the use of mechanisms, apparatus or other appliances, and which shall, by the application of such means or methods, evolve a commercial or marketable article or commodity possessing added features not present in the material used before the said application.

"Chemical."—A "chemical" shall be defined as:—A substance which has a recognised degree of purity, composed of an elementary body, or a combination of elements in definite proportions and of a fixed composition, which may either have been produced, made, formed or fabricated by physical or chemical processes, from another substance or substances, or obtained by the application of physical or chemical means or processes, or both, from a substance or substances which occur in nature, or formed by, or produced from, plant or animal organisms or their products.

The degree of purity—that is, the percentage of the chemical element, or compound, having a fixed composition which classifies the name of the chemical—shall be dependent upon the specific trade name, practice or definition, or, where such does not exist, shall be determined by a specification agreed upon, at the making of the contract, between the buyer and seller.

"Synthetic."—A "synthetic" chemical shall be defined as:—A chemical compound which has been produced, formed, made, or fabricated by the combination of elements, or an element and simple compound, or simple compounds, by the application of physical or chemical processes, or both, whereby a more complex compound is built up.

"Organic."—A so-called "organic" chemical shall be defined as:—A chemical (*vide* definition of chemical) which contains the element carbon, or carbon in a definite state of combination with other elements.

Organic chemistry is in reality "the chemistry of elements united and grouped together, known or such, or shortened into "Carbo-chemistry." The above definition is based upon this contention.

ARTIFICIAL DISINTEGRATION OF THE ELEMENTS.

In a lecture on the above subject delivered before the Chemical Society on February 9, Sir Ernest Rutherford reviewed recent work upon the action of α -particles on certain elements and its bearing on the modern nuclear theory of the structure of atoms.

The evidence at present available indicates that the complex nuclei of all atoms are built up of hydrogen and helium nuclei and electrons, and that, probably, the helium nucleus itself is a secondary unit composed of four hydrogen nuclei and two electrons. The diameter of the nucleus of heavy atoms is about 4×10^{-12} cm, and that of the helium nucleus about 5×10^{-13} cm.

Investigation of the phenomena of atomic disintegration by means of swiftly-moving α -particles has shown that these are expelled from radium with a velocity of about 10,000 miles per sec., and that although such a particle may penetrate a heavy nucleus if fired directly at it, its energy at that stage may be too small to cause disruption. On this account the attack on the lighter elements is more promising. In this case, the method employed consists in determining, by a scintillation method, the range of ejection of particles from the atomic nuclei of various gases submitted to bombardment by α -particles emitted from radium-C. By using thin foil or fine powder dusted on thin gold foil and exposed in the paths of the α -particles, the method has been extended to the investigation of the nuclear structure of some of the heavier elements. Lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, sodium, magnesium, aluminium, silicon, phosphorus, sulphur, chlorine, potassium, calcium, titanium, manganese, iron, copper, tin, silver and gold have been examined in this manner. Of these, boron, nitrogen, fluorine, sodium, aluminium and phosphorus afford particles ejected from the nucleus having a range greater than 32 cm. of air, which is the normal range of ejection from the hydrogen nucleus. Experiments have shown that in all cases the ejected particles consist of hydrogen atoms liberated from the nuclei of the respective elements, and it is concluded that for all collisions in which the liberated hydrogen atom has a range greater than 56 cm. of air, a part of the energy of the emitted atom is derived from that of the disintegrated nucleus. This is the case with aluminium and phosphorus, the respective ranges for which are 90 to 65 cm.

It is of interest to note that hydrogen atoms are liberated only from elements whose atomic masses are given by $4n+2$ or $4n+3$, where n is a whole number, a result which is in accordance with the assumption that the nuclei of these elements are composed of helium nuclei of mass 4 and hydrogen nuclei. The helium nucleus appears to be the most stable of all nuclei. In the case of light elements, it appears probable that the effective mass of the hydrogen nuclei, or "protons" constituting the nucleus, will vary in different atoms from about 1.007 to 1.000, depending on the closeness of combination. Probably, therefore, the whole-number rule of Aston for the expression of atomic weights would be found not to hold if measurements could be made with a greater accuracy than 1 part in 1000, now the limit.

Disintegration of atoms by means other than bombardment with α -rays has so far not been found possible. The results of Sir William Ramsay, indicating the production of neon and lithium from copper, lack confirmation, also that of Collie on the production of helium by the action of intense electric discharges upon the electrodes employed. In general, the evidence indicates that atoms as a

whole are such stable structures that only the most concentrated source of energy is likely to effect their disintegration. Only a few out of every million α -particles employed are effective in this respect. If charged particles possessing ten times the energy of the α -particle from radium were available, the nuclei of all atoms could probably be penetrated and their disintegration occasionally effected.

CHEMISTS AND THE PATENT LAWS.

On February 24, Mr. Horatio Ballantyne delivered to the Institute of Chemistry a lecture on "Chemists and the Patent Laws," which was sub-divided as follows:—(1) Introductory (mainly historical); (2) Patents and Industrial Research; (3) Chemists and the Patenting of Inventions; (4) Some Elementary Principles and Examples; (5) Foreign Patents; and (6) The Patents and Designs Act, 1919. We reproduce below certain portions of the lecture which we think will be of particular interest to readers of this Journal:—

It must, I fear, be admitted that we chemists as a class, though with some notable exceptions, have hitherto shown a diffidence about availing ourselves of the advantages of our patent laws. The output of patented inventions—especially those of our more highly skilled chemists and those which break really new ground—has hardly been commensurate with the quality and number of the chemists engaged in industrial pursuits in this country. This fact, in my judgment, has been due in no small degree to a certain shyness, an unduly modest appraisal of the worth of our own achievements and professional capacity, and perhaps a temperamental reluctance to embark, in the midst of our regular duties and responsibilities, upon those quests into the unknown which must be undertaken by every inventor who would accomplish anything worth recording.

The patent laws offer advantages in a very special degree to chemists. The training and occupation of the chemist are not such as to produce the energetic, managing man of affairs. His work, as a rule, is of a contemplative nature; he is concerned more with the reactions involved in the process of manufacture and the conditions governing them than with the devising of plant and machinery, or organisation of departments for production in quantity. Speaking generally, his contribution to improvements in chemical manufacture consists in initiating and working out, in its early stages, the fundamental principles of the process; he rarely gets further beyond that than some tests on a small-scale experimental plant. There his work on the invention ceases, unless, as is not usually the case, he has a natural aptitude for management and business. From that point onwards the development and daily commercial use of the process pass into the hands of the engineer or manager, who deservedly gets the credit of "producing the goods." Too often the real originator receives inadequate recognition for the success achieved; he occupies a subordinate post, and is called in only when difficulties arise, or for the routine control of raw materials and products.

To some extent this disparity of recognition may be rectified if the chemist records the advances, which he has made, by patenting them. The name of the first and true inventor must appear upon the specification, and the patent thus affords for all time a definite record of his personal achievement.

If the conduct of the process passes out of his hands, his name nevertheless remains coupled with it.

To the young chemist his patent serves as a diploma which, whether the invention prove to be commercially valuable or not, bears independent testimony to initiative, to some measure of ingenuity, on the part of the patentee. It is always a cause of gratification when applications for admission to the Institute are accompanied by such evidence of the capacity of the candidate.

Chemists as a rule entertain a somewhat exaggerated idea of the quantum of originality or scientific achievement that is necessary to justify them in applying for patents. I would not wish to advocate the cultivation of a habit of rushing off to the Patent Office with every little improvement, but, on the other hand, it is not wise to allow diffidence, or a lack of a right sense of perspective, to restrain one. I have a vivid recollection of a visit, some years ago, from two chemists who are now among our most distinguished Fellows, who came, blushing like a pair of school-girls, to discuss whether, by chance, there was anything worthy of patenting in what was really a brilliant chemical invention which they had made. To them the process, the outcome of prolonged investigations, seemed so obvious—once it was made, and consisting as it did of the application of a known chemical reaction to a particular new purpose—that they shrank from what seemed like patenting a platitude.

The tendency of the Courts, in my experience, is always to regard chemical inventions with special sympathy. The "inventive idea" is, as a rule, easier to formulate and envisage in these than in mechanical combinations.

It is not necessary that the invention be based on profound scientific conceptions or upon new reactions. Quite a small advance, judged from the purely chemical standpoint, if applied to the production of a new and useful result, may afford good subject matter.

There is a class of invention which I think is apt to be overlooked by British chemists, viz., inventions which consist in improvements in detail. The investigator works away, ascertaining the best conditions of concentration, proportions, temperatures, circulation of liquids, sequence of operations, and so on, and one by one small improvements emerge which are translated into practice with, in the aggregate, a substantially beneficial effect on the purity, yield, or cost of the product. Any chemist worthy of the name takes this sort of effort as a matter of course. It is as well, however, to pause now and again on the journey up the hill and survey the scenery below from the new vantage point. Sometimes, though by no means always, it will be found that on crystallising the ideas which have served as guiding principles from stage to stage of the ascent, a real inventive conception will emerge. If he can patent the whole, he will secure to himself credit which may well be lost through considering each little advance by itself.

Having made your invention, any competent patent agent possessed of adequate chemical knowledge may, provided he is supplied with all the requisite information, be relied upon to do what is necessary in the important work of drafting the specification. It is absolutely essential, however, that the frankest and fullest disclosure of all relevant facts be made to him. If you feel that you can also crystallise what you conceive to be your invention into a short statement, extending to only two or three lines in length and specifying all its essential features, you will assist him by formulating it in that way. It is of special importance, in the case of chemical inventions, to attend to the following points:—

(I) Try to ascertain, with scrupulous care, all the factors necessary for the successful performance of

the invention, and, having done so, give in the specification full and clear information, illustrated by definite examples. I cannot too strongly press this counsel upon your consideration. A very large part of the costly litigation which has occurred in connexion with chemical patents in the past has been due to "insufficiency" of this sort. I am happy to say that, so far as my experience goes, such faults are almost unknown in the specifications of British inventors. No doubt the defect, when it occurs, is to some extent due to the differences which exist in the requirements of the patent laws of different countries; but whatever the cause, the defect is a serious one from our own standpoint. The bargain between the Crown and the patentee requires that the informed public—in this case, competent chemists, skilled in the particular art—shall be placed by the specification in full possession of all the knowledge requisite for successfully using the invention, and anything short of a full disclosure not only imperils the validity of the patent, but is obviously unfair to the public. A "full disclosure" does not mean a dissertation on the subject; but it is better to furnish your patent agent with a lengthy description, from which he may select the essentials, than to run any risk of failure in this respect.

(2) Avoid the introduction of theory into your specification, unless the circumstances are very special and your patent agent considers it necessary—and in the latter case make plain that it is theory. The temptation to resort to theoretical conceptions in elucidating chemical inventions is sometimes very great; none but a chemist can appreciate how helpful, as a real, practical guide, chemical theory can be and generally is. Your invention, as formulated under the sagacious advice of your patent agent, may at first sight appear rather bare. You have been contemplating, perhaps, not only particular substances, but groups or whole classes of compounds; not reactions applicable only to a few, but general reactions such as your studies and experience have familiarised you with. Your patent agent sees, lurking in such broad ideas, the danger that the claims may extend to substances or to conditions of working which result in failure. There are cases, especially in the domain of organic chemistry, where it is almost impossible to avoid theory; it is then all the more necessary to seek the aid of a patent agent who has an adequate knowledge of chemistry to guide you.

(3) Do not overstate what the invention can accomplish. Nearly all inventors are enthusiasts, who do not relish seeing their inventions stated in modest terms. Now, if an invention consists in a process or apparatus, it is plain that no laudatory expressions can assist in describing that process or apparatus. Commonly it is an advantage to indicate what the object of the invention is; sometimes, but more rarely, it is advantageous to indicate what the invention is claimed in fact to achieve.

Chemical industry is at present passing through a period of great difficulty and anxiety, and for the time being pioneer work is perforce largely suspended. But one of the legacies of the war, as we well know who have observed the marvellous expansion of the Institute and its activities in the past few years, has been the growth of a spirit of keenness and steady enthusiasm among our young chemists, conscious of their strength and, as I firmly believe, only waiting for a favourable opportunity to justify themselves by their deeds. There is at present in these islands a larger body of younger men of proved capacity and manufacturing experience than ever before in our history. May we cherish the proud hope that with a return of industrial activity there will be forthcoming a generous and fruitifying stream of chemical inventions, making a worthy contribution to the lasting prosperity of the nation.

NEWS FROM THE SECTIONS.

CANADIAN PACIFIC.

A meeting of this Section was held at the Board of Trade, Vancouver, on February 1, 1922, at which Dr. M. G. Marshall, of the University of British Columbia, read a paper on the "Adsorption of Gases by Charcoal." Prof. E. H. Archibald, of the same University, and chairman of the section, presided.

The paper dealt with the results of an important research carried out by Dr. F. G. Keyes and the author in the Research Laboratory of Physical Chemistry of the Massachusetts Institute of Technology. The investigation was undertaken as a consequence of the use of charcoal in gas-masks during the war. Exceedingly sensitive apparatus was described for measuring the heat emitted when various gases are exposed to highly purified charcoal. From the resulting heat effects it is concluded that oxygen and, probably, chlorine form chemical combinations with the carbon at the surface of the charcoal. Other gases, *e.g.*, hydrogen, do not combine chemically with the carbon, and are therefore absorbed in very small quantities. This work and that of previous investigators indicate that the adsorption of gases by charcoal is not due to the small size of the pores, but rather to the large surface offered for attachment of the gas molecules. The actual forces causing adsorption are in some cases due to both primary and secondary chemical valences, whilst in other cases secondary valences alone are involved. Some practical applications were instanced, such as the removal of nitrogen from helium gas for use of the latter in observation balloons and dirigible airships. Dr. Marshall is continuing the investigation at the University of British Columbia. A discussion followed.

After the meeting steps were taken to form the British Columbia Chemists' Club, Mr. Horace Freeman being appointed president and Mr. Norman Armstrong secretary-treasurer. The Club will interest itself mainly in the local chemical industries.

OTTAWA.

During the current session meetings of this Section have been held in November, December, January, and February. At the first of these the chairman, Mr. Fred. J. Hamby, gave an address on the present tendency of chemistry, and at the second, Dr. Alfred Tingle, chief chemist to the E. B. Eddy Co., gave a lecture on "Paper Problems and Some Solutions."

Emphasising the great variety of material which can be used in the manufacture of paper, the speaker pointed out that cotton and linen rags now play a small part, even as they did among the first inventors of paper, the Chinese. Since any fibrous vegetable matter could be turned into paper if properly treated, the chemistry of paper-making would have no unity but for the fact that all these fibres were composed very largely of cellulose. Much of the science and art of paper-making depended on so treating a particular class of fibre that it would do the work of some other fibre, and do it better. Dr. Tingle then discussed in detail the chemical changes which take place during the manufacture of paper from sulphite pulp, and said that some were very obscure, because pure science had not yet caught up with technical practice. Several foreign universities were carrying on a close study of paper-makers' materials from the purely scientific standpoint, and advances were being made by paper chemists both in Canada and abroad. There were, however, many questions linking the discoveries of pure science with the work of the

technologist which could not be carried out either in the universities or in the factories, and it was there that Government institutions, such as the Forest Products Laboratory in Canada, should step in. Up to the present the work of the Canadian Government had been only of the nature of routine survey work, and a more intensive study along the lines followed in the United States and elsewhere was now needed. A vote of thanks was passed to the Natural Resources Intelligence Branch for the preparation of the lantern slides used to illustrate the lecture.

An interesting feature of the evening was the presentation of short reviews by several of the members covering recent progress in industrial chemistry.

The programme of the January meeting consisted of short papers devoted to the following subjects:—Tests for strains in non-ferrous metals; the generation of steam by electricity; peat problems; possibilities of the Canadian Institute of Chemistry; precise definitions of the words: chemical, fine chemical, manufactured, organic, synthetic, derivative.

Mr. Hamblly referred to the attention being given in Canada to the utilisation of surplus electric energy for the generation of steam for heating purposes. He outlined the procedure used and stated that the electric steam-generator was practically automatic in its action, could be cheaply installed, and that at the present time more than 20,000 electric horse-power was being utilised in Canada in this way.

Dr. A. Macintyre exhibited samples of cartridge cases which had been improperly annealed, and which as a consequence cracked owing to the internal stress set up. He also outlined the methods for testing brass for the purpose of determining whether the annealing has been complete. The speaker dealt at length with the war experiences of small-arm ammunition-makers, in connexion with the subject of season-cracking of the non-ferrous metals.

Mr. H. A. Leverin, of the Mines Branch, outlined some of the problems confronting the chemists connected with the utilisation of the peat resources of Canada. He described some of the work which had been done with a view to removing more cheaply and more efficiently the 90 per cent. of moisture which exists in the peat as it is dug.

The subject of the Canadian Institute of Chemistry, which was to have been introduced by Colonel Janson, was passed over by agreement as the hour was getting late, and Colonel Janson turned to the precise definitions of the words: chemical, fine chemical, manufactured, organic, synthetic, derivative. After lengthy consideration of this subject a committee consisting of Messrs. Macintyre, Thornton and Janson was appointed by the chairman to prepare definitions for consideration at the next meeting. The secretary undertook to send copies of these definitions to each of the members in time for the next meeting.

NEWCASTLE-ON-TYNE.

The annual meeting was held on March 1, Dr. J. H. Paterson presiding. The number of nominations to the committee being equal to the number of vacancies, no ballot was taken, and the following were elected to serve on the committee for the session 1922-23:—Chairman, Mr. A. Trobridge; Vice-chairman, Dr. J. H. Paterson; Hon. Sec. and Treasurer, Mr. H. D. Smith. Committee: Profs. H. V. A. Briscoe, N. W. Haworth and H. Louis; Drs. P. E. Bowles, W. B. Davidson, J. T. Dunn, A. Fleck and G. Weyman; Messrs. F. Hirsch, D. W. Jones, A. Short and F. H. Walker. Subsequently a demonstration was given of the Sheringham Day-

light lamp, and papers were read on the constitution of golden sulphide of antimony used in the rubber industry, by Mr. A. Short, and on modern gas-producers and the application of producer and other gases to furnace-work, by Mr. N. E. Rambush.

Prof. C. H. Desch has recently delivered a series of lectures on Cement, and on March 23 a dinner was given at which Mr. E. V. Evans, hon. treasurer of the Society, was the principal guest.

GLASGOW.

Prof. F. J. Wilson presided at the meeting held on March 3, when a paper entitled "Hydrogen Ions in Biochemical Processes" was read by Mr. R. H. Hopkins, of the Heriot-Watt College, Edinburgh.

In introducing his subject, Mr. Hopkins referred to the great attention which was being given to the study of the influence of hydrogen ions, both in the reactions of the laboratory and in manufacturing processes, particularly those depending upon enzyme action. The method of expressing hydrogen-ion concentration was considered and the Sørensen notation recommended. The electrometric method, involving the use of a hydrogen electrode, was described as the more accurate, and its application in electrometric titration was considered especially valuable when solutions were coloured and when interfering substances were present. The author then discussed the composition and use of buffer solutions, and in concluding he showed that a knowledge of the subject was of very great importance to the bacteriologist, the physiologist, the agricultural chemist, and the biochemist.

NOTTINGHAM.

At the fourth meeting of the session, held on March 1, Dr. E. B. R. Prideaux and Mr. H. Hewis read a paper on "the anodic corrosion of bismuth, with some notes on bismuth compounds. The metal bismuth, which is the basis of so many pharmaceutical preparations, is generally dissolved in nitric acid in the first place. Experiments carried out at University College have proved that by making the metal the anode in a solution of sodium nitrate it can be dissolved with maximum current efficiency. It is obtained as oxynitrate, or partly in solution as trinitrate. From the solution the white hydroxide is prepared, and from this salts with organic acids can be obtained in a pure form. The substance "Xeroform" was also investigated and proved to be a mixture essentially different from bismuth tribromphenate.

Mr. B. Collitt then gave a short account of a visit to Canada with impressions of the Annual Meeting of the Society. He was struck by the excellence of the publicity arrangements and the space devoted to the meetings in the local newspapers, and also noted the possibilities offered by the cinematograph for demonstrating manufacturing processes.

The annual general meeting was held on March 15, with Mr. J. H. Dunford in the chair. After the annual report and balance-sheet had been presented, the conditions of associate-membership of the Section were announced as follows:—Age limit at election, 25; continuance until the associate member reaches 25, or for 3 years, whichever be the longer period; election by the committee on the proposal of one full member.

At the close of the meeting the following officers were declared elected for the ensuing year:—Chairman: Mr. S. H. Burford; Vice-chairmen: J. H. Dunford, H. D. Richmond; Hon. Treasurer: S. J. Pentecost; Hon. Secretary: J. M. Wilkie; Ordinary Members of Committee: D. J. Law, E. B. R. Prideaux, A. D. Powell, J. White, J. Marshall,

S. R. Trotman, J. T. Wood, W. Woodhouse, L. Archbutt, J. B. Firth, F. S. Kipping, W. P. Skertchly.

Following the annual meeting a lecture entitled "Enzyme Action in the Light of Modern Theories of Catalysis" was given by Dr. E. F. Armstrong.

Various difficulties which had formerly invested enzyme catalysis with unnecessary mystery were resolved by modern theories, especially those of surface action associated with the names of Hardy and Langmuir. Dr. Armstrong strongly favoured the view that a definite chemical compound of molecular thickness existed on the enzyme surface. The effect of a high degree of dispersion in promoting the chemical action and the destructive effect of too high a temperature were illustrated by analogous effects on the nickel catalyst in the hydrogenation of oils. The highly selective character of enzymes, the rôle of co-enzymes in physiology, abnormal fermentation, promotion of reverse reactions were among the subjects discussed. The rate of reaction measured was probably that of the decomposition of the compound enzyme-substrate.

In the discussion which followed, Mr. Richmond referred to the increase of action with temperature, the attainment of an optimum and subsequent rapid decrease in the action of the enzyme. He asked how the hydrolysis could proceed at a constant rate in the case of methyl glucoside, if the glucose formed were combining with the enzyme at the same time. Mr. Wood asked if it were not a fact that the ions derived from water began the actions. Dr. Firth mentioned adsorption on carbon as being an analogous case. Mr. Gray and Mr. Burford inquired concerning the fermentation of tartrates by *Penicillium glaucum* and the function of water in the hydrolysis of bitter almonds by emulsin.

Dr. Armstrong, in reply, said that the selective action of enzymes was controlled by the living cell, e.g., *Penicillium glaucum*. In the almond the amygdalin and emulsin were in separate cells; they were brought into contact in the water which then exerted its hydrolytic effect. In reply to Mr. Richmond, he sketched his views of the mechanism of enzyme action. The enzyme must be similar in constitution to the glucoside (or glucose) which were adsorbed on the surface. The dissociation of the complex was probably the slowest reaction. In hydrogenation by nickel the complex could not only decompose giving stearic acid, but it could also regenerate olein and its isomers elaidic and iso-oleic acids.

LONDON.

On March 6, at Burlington House, W., Mr. E. V. Evans presiding, a paper entitled "Gold Metallurgy of the Witwatersrand, Transvaal," was read by Mr. W. Cullen.

The output of gold from the Transvaal amounts to about 50 per cent. of the world's production and is valued at nearly £35,000,000 per annum at standard price. The "banket" in which the gold occurs extends in the form of reefs which dip beneath the strata from north to south. Most of the outcrop mines are now worked out, but an almost continuous line of underground mines extends for fifty miles from east to west in the rich Eastern Rand district. At the present time some of these mines are being worked at a depth of 6000 ft. below the surface, and over 20,000 tons of high explosives are used annually for blasting purposes. The development and equipment of a mine take from three to seven years, and at the present time would cost at least £3,000,000 sterling.

The ore, on reaching the surface, is stored in huge bins and discharged by conveyor-belts into a building where it is sprayed with water and washed to remove "fines," which consist of the smaller

fragments and dust and amount to about 40 per cent. of the whole. The "fines" are run directly to the stamp or tube mills, and the lumps of ore are transferred to moving belts from which the barren rock is removed by hand. The cleaned ore is then crushed to a pebble size and passed to the stamp mills which pulverise it with water into "pulp." This pulp is separated by conical classifiers into "slime" and coarser material; the former is sent direct to the cyaniding plant, and the latter to the tube mills, and thence to the amalgamating tables, where up to 70 per cent. of the gold is removed by solution in mercury amalgamated upon the surface of copper sheets. The partly-extracted ore is again separated into slime and sand, each of which is separately treated for several days with sodium cyanide until the remaining gold is dissolved, the slime being then removed from the solution by means of leaf filter-presses. The gold retained on the amalgamated copper sheets is recovered by distilling the mercury from the alloy and that from the cyanide solution by deposition of the metal upon ribbon zinc upon which a surface coating of lead is deposited. The exhausted tailings were formerly dumped into immense heaps, which in dry, windy weather were a source of nuisance, but now they are made up into pulp and pumped back into the mine from which they were extracted.

At present one-half of the Rand mines is making no profit, and some are working at a loss owing to the increased cost of labour and materials, but by the adoption of new processes, which will only produce one product, slime, the whole cycle of operations will be simplified, for both stamp crushing and amalgamation will be eliminated. This will materially reduce operating costs and the capital outlay for new plants. Further economies are also expected from the refinery which started operations a few months ago. The mint, which is situated at Pretoria, will also soon be at work, but the minting of gold coins will make no difference to the mines.

YORKSHIRE.

The fourth meeting of the session was held in Sheffield on March 13. Mr. S. H. Davies, who presided, remarked that it was eleven years since the Yorkshire Section had held a meeting in Sheffield, and he hoped that the meeting would be held there more frequently in the future.

Dr. F. Rogers read a paper on "Corrosion of Metals." After pointing out that the subject covered a very wide field, he stated that one of the objects of his work had been to devise a laboratory test of corrosion which would give rapid results comparable with the behaviour of the materials in actual use. The most satisfactory method he had found was to polish the test-piece, and after weighing, to immerse it in an acid of definite strength maintained at the boiling-point for a measured time. The sample was then removed, washed, dried and re-weighed. The results were expressed as the loss in weight per unit surface per hour. Typical results were quoted showing that in general the "stainless" (unstainable) steels increased their resistance to corrosion on hardening. With the silicon cast irons it was found that little improvement in resistance to acid was obtained either by the addition of other metals or by lowering the carbon. The rôle played by atmospheric dust in assisting corrosion was illustrated by photographs, in which corrosion was seen to have commenced at the points where dust particles had collected. The lecture was illustrated by micrograph lantern slides showing the composite and crystalline structure of the metals investigated. In referring to the well-known Delhi column, the author advanced a novel hypothesis to explain why this ancient monument re-

sisted corrosion. He suggested that the atmosphere at Delhi was laden with very fine particles of dust (sand) from the neighbouring desert, and that these, when blown by the winds, would exert a kind of polishing action, insufficient to cause erosion, but sufficient to inhibit rusting.

LIVERPOOL.

"The Industrial Treatment of Fumes and Dusty Gases" was the subject of a paper presented to this Section on March 17 by Dr. W. E. Gibbs.

Smokes, fumes and dusty gases can all be regarded as disperse systems, in which the dispersed substance is solid or liquid and the dispersion medium a gas. It is convenient to distinguish three kinds of disperse systems in gases, according to the size of particle (degree of dispersion):—(a) Dusts, in which the particles are larger than 10^{-3} cm. diameter. Such particles settle in still air with increasing velocity. They do not diffuse. (b) Clouds, the particles of which range in diameter from 10^{-3} to 10^{-5} cm. Such particles settle in still air at a constant velocity, depending upon their size, according to Stokes' Law. They, also, do not diffuse. (c) Smokes, the particles of which range from 10^{-5} to 10^{-7} cm. diameter. Such particles are in active Brownian motion, and diffuse fairly rapidly. They do not settle at all in still air.

The settling of dust is facilitated (a) by retarding the velocity of the gas—e.g., by cooling it, by increasing the cross-sectional area of the flue, by the introduction of baffles; (b) by centrifugal action in a cyclone or in a rotating cylinder, or by sudden changes of direction of the gas; (c) by loading the particles with water—e.g., by cooling the gas below its dew-point, by the introduction of water sprays; (d) by introducing suitable baffles, e.g., Freudenberg plates, Roesing wires. In some cases the removal of particles by such baffle-plates is facilitated by increasing the force of the impact between the particles and the plates. Settling methods are only applicable to actual dust particles and are of little use for clouds or smokes.

Filtration is essentially a special type of baffling. The particles are deposited upon the filtering surfaces rather than screened out by the pores of the filter. Filter-towers filled with coke, etc., if efficient, soon become choked and are troublesome to clean. They have been superseded by bag filters (made of wool, cotton or, sometimes, asbestos) through the walls of which the fume or dusty gas is forced or drawn, but whose usefulness is limited by their tendency to char or disintegrate at temperatures much above 100° C. Wool and cotton are rotted by the condensation of acid, if the temperature of the gas falls below the dew-point. In some cases, acid fumes are neutralised with lime or zinc-oxide dust before being filtered. Sharp, gritty particles cut the bags. Filter mattresses, filled with metallic wool, are also used. In some cases, the fume is drawn or blown through loose granular material such as sand. Filtering processes absorb a large amount of power, although it is often an advantage to collect the product in a dry condition.

The efficiency of a smoke-washer depends upon the smoke being brought into intimate contact with the water. In all washing processes, intimate contact can only be brought about at the cost of high power-consumption. Even when intimate contact is obtained, some smoke particles are difficult, or almost impossible, to wet. For acid fumes washing processes necessitate the use of expensive acid-resisting plant. Washing processes are used successfully for coal gas, producer gas, and the small amount of iron blast-furnace gas that is used for gas-engines.

The removal of smoke particles by electrostatic precipitation was also described and illustrated by lantern slides.

MEETINGS OF OTHER SOCIETIES.

THE INSTITUTE OF METALS.

The annual meeting was held in the rooms of the Institution of Mechanical Engineers, S.W., on March 9 and 10. After the formal business had been concluded, the new president, Mr. Leonard Sumner, took the chair and delivered his presidential address, which dealt mainly with the commercial aspect of metals, and the important work the Institute had done, and was doing, to promote the commercial prosperity of the industry. Until a few years ago manufacturers contributed little to the fund of common knowledge, and there was a great tendency to hide manufacturing methods, and keep them as secrets. During the war this spirit was partly overcome, and co-operation between producers was now much more common than formerly. Mr. Sumner appealed for more support for the Institute from merchants, and expressed the opinion that it would be to their advantage to learn more about the products in which they dealt than many of them knew at present. In speaking of the education of scientific workers, he commented on the difficulty of obtaining scientifically trained men who were fitted to manage works, and appealed to professors and teachers to give that aspect of training their consideration.

Dr. G. D. Bengough presented a paper on "Notes on the Corrosion and Protection of Condenser Tubes." The paper was a summary of the considered views of the author, who has been investigating the problem of corrosion in condenser tubes for ten years, but before publication it was submitted to certain manufacturers, and to the Corrosion Committee of the Institute of Metals, by whom it was approved. The report therefore presents the most authoritative expression of opinion on the methods of protecting condenser tubes from corrosion that it is possible to prepare at the present time. Serious corrosion is usually the result of a number of factors working together, and the author gives a long list of possible causes, under two headings—causes due to the tubes, and causes due to external conditions. Perhaps the most interesting part of the paper is that dealing with the protection of tubes. On account of the great variety of causes of corrosion, no one method can be expected to afford protection in all cases, and the method used must be selected with reference to the causes influencing the corrosion. The methods suggested include physical or chemical treatment of the water, electrolytic protection, protective coatings (oxidised layer, insoluble salts, lead or varnishes), and the use of special alloys.

Mr. F. Adcock read a paper on the "Internal Mechanism of Cold Work and Recrystallisation in Cupro-nickel." The microscopic examination of rolled cupro-nickel shows that during deformation the grains of the metal are caused to extend by a process of "faulting" in the crystal grains. The orientation of the grains in relation to the direction of rolling appears to control the direction of the "fault planes." The deformed grains usually possess a constant orientation throughout, though in a few cases signs of a "bending" of the orientation were found. The fault planes were indicated by approximately straight "etch bands" on polished surfaces. On reheating such alloys to suitable temperatures, recrystallisation began, and the first new crystals to be formed were found either in the "etch bands," or in striations running in the direction of rolling, or in the boundaries of the distorted grains. The new crystals were not equiaxial, but were elongated in the direction of the bands. The author suggests that the etch bands are zones of disturbed or amorphous metal, in which

crystal fragments are embedded, and that these fragments act as nuclei from which recrystallisation commences.

A paper on "The Effect of Impurities on Recrystallisation and Grain Growth" was presented by Major C. J. Smithells. The effect of small quantities of thorium, lime, alumina, silica, and alkali oxides on the recrystallisation of drawn tungsten wire was investigated. The impurities were introduced into the metal powder before it was sintered. Annealing was carried out *in vacuo* by making the wires into filaments of electric-lamp bulbs, and an annealing temperature of approximately 2500° K. was adopted throughout. Thorium and lime have a marked restraining influence on grain growth; alumina and silica exhibit the same property in a less degree. The author concludes that insoluble impurities of this kind segregate to the grain boundaries during annealing, provided sufficient time be given, and that this segregation hinders grain-growth. Sodium, tungsten and oxygen combine to form compounds known as "bronzes," which are soluble in metallic tungsten. Tungsten containing "bronze" together with an insoluble impurity develops crystals of large size on annealing. The author puts forward a general theory of grain growth to explain the known properties of metals. According to this theory, grain growth takes place by a process of distillation, and the growth of one grain at the expense of its neighbours takes place if its vapour pressure is lowered. The lowering of the vapour pressure may be caused by a dissolved substance, and the grain growth will become exaggerated in the presence of an insoluble impurity which restrains the growth of the normal grains. Large grains are held to have a lower vapour pressure than small grains, so that a large grain will grow at the expense of a small grain. The effect of strain in producing grain growth is explained, according to this theory, by assuming that the strained portions have a higher vapour pressure than the unstrained portions. The author reviews the modern views on recrystallisation, and points out that a complete explanation of the phenomena of recrystallisation has never been given. Prof. H. C. H. Carpenter, in discussing the paper, criticised the correctness of the assumptions on which the theory is based.

Dr. H. Moore and Mr. S. Beckinsale have extended their study of season-cracking and its prevention to include condenser tubes. They show that certain cases of cracking are associated with high internal stresses in the tubes. They have investigated the conditions under which such stresses can be removed without seriously reducing the strength and hardness of the material. They conclude that annealing for 30 minutes at 280° to 300° C. would remove all liability to season-cracking in the case of tubes made of 70:30 brass or Admiralty condenser-tube brass, and would at the same time improve the properties of the material, especially in the harder tubes, by increasing the elastic limit. At the same time the treatment could be so regulated to give a protective oxidised surface.

Prof. C. A. Edwards and Mr. A. J. Murphy described experiments on "The Rate of Combination of Copper and Phosphorus at Various Temperatures." They found that the rate of combination attained a maximum at about 670° C., at which temperature an alloy containing 15 per cent. of phosphorus was obtained. Above this temperature the alloy lost phosphorus. In general an alloy contained more phosphorus the lower the temperature at which combination took place.

Dr. W. Rosenhain described "Some Cases of Failure in 'Aluminium' Alloys," and pointed out that certain types of disintegration, said to be characteristic of aluminium alloys, were associated

with alloys rich in zinc. Two cases described had occurred in alloys containing 81 and 54 per cent. of zinc, respectively.

Dr. D. Hanson and Miss Gayler presented a new constitutional diagram for the alloys of aluminium and zinc. They showed that the compound Al_2Zn_3 was not formed in this system, but that the beta-constituent was an intermediate solid solution of variable composition. They also showed that the delta-constituent, shown on former diagrams, could, by suitable etching methods, be resolved into two constituents. The reaction at 256° C. was a eutectoid transformation of the beta-constituent. This constituent was shown to be unstable at ordinary temperatures in alloys that had been quenched, and some remarkable age-hardening properties were found to be associated with its decomposition.

Papers by Prof. F. C. Thompson and Mr. E. Whitehead on "Some Mechanical Properties of the Nickel Silvers," and by Mr. A. Westwood, on "The Assay of Gold Bullion" were also read.

ROYAL SOCIETY OF ARTS.

At a meeting held on February 24, a paper on "Lignites and Brown Coals and Their Importance to the Empire" was read by Prof. W. A. Bone, who treated the subject under the following heads: origin and classification; properties; geographical distribution; the brown-coal industries of Central Europe; importance to the British Empire; and observations on utilisation and improvement. In illustrating the importance of lignites to the British Empire, special reference was made to the vast deposits in Australia, at Morwell, where an area 50 miles long and 1000 ft. deep is estimated to contain 31,144 million tons of brown coal.

In the concluding portion of his paper Prof. Bone gave a detailed description of attempts to improve the fuel values of brown coals and lignites for steam raising. He pointed out that their carbonisation, after drying, was no more difficult than carbonising a low-grade, non-coking, bituminous coal; there was also no special difficulty in gasifying lignites in producers. Such fuels should be dried with waste heat; hot chimney gases could be used provided they contained more than 10 per cent. of carbon dioxide, which was necessary to prevent ignition of the dried fuel. When dried Morwell brown coal was subjected to a heat treatment between 250° and 375° C., a chemical condensation occurred in the coal substance accompanied by a loss of $\frac{1}{4}$ of the oxygen, $\frac{1}{6}$ of the hydrogen, and only $\frac{1}{3}$ of the carbon, but by a marked improvement in the calorific value (cf. J., 1921, 499 A). It was subsequently found that this heat treatment afforded a ready means of "up-grading" brown coals and lignites generally and improving their fuel values. An apparatus, called the "fuel improver attachment," had been designed for drying and "up-grading" the ingoing raw fuel at the expense of part of the heat of the outgoing products of its combustion. The apparatus, which had given very good results in preliminary trials at Morwell, consisted essentially of an iron casing, made practically air-tight and fitted with two parallel series of cast-iron plates arranged like a louver so as to form a chute with open sides, down which the raw coal passed and met the hot gases. In the experimental plant the hot gases leaving the boiler first came into contact with the raw ingoing fuel, as there was less likelihood of ignition if the gases at their highest temperature met the fuel with its maximum water content. If this precaution proved unnecessary the counter-flow principle would be adopted in future. At the present rate of operation about 2.1 tons of raw fuel passed through the apparatus in 45 minutes.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

The ninth annual general meeting of this Institution was held at the Royal Society of Arts on March 14, the president, Prof. J. S. S. Brame, being in the chair.

The report of the council and the balance-sheet for 1921 were presented and adopted, and certain proposed modifications of the bye-laws were approved by a large majority.

The president then delivered his address, taking for his subject the proposal to re-establish the International Petroleum Commission.

International petroleum congresses were held in 1900, 1904 and 1908, and committees were appointed to establish methods of testing products. Little was actually achieved, and in 1909 an International Petroleum Commission of wider scope was instituted. The organisation of an English national section was referred to the Institution of Petroleum Technologists by Engler and Ubbelohde, but the intended meeting of the Commission at Bucharest in 1911 was prevented by the outbreak of war.

At the first annual meeting of the Petroleum Products Section of the Société de Chimie Industrielle at Paris in 1921, M. Schmitz suggested the reconstitution and endowment of this Commission, to be centred at the University of Strasbourg. He spoke somewhat bitingly of the Americans "profiting by the general disorganisation to seek to abandon the analytical methods previously decided upon in favour of their own."

Prof. Brame expressed grave doubts as to the wisdom and the justice of M. Schmitz's address. He could not believe that the largest oil-producing country, which had created such splendid organisations as the Bureau of Mines and the American Society for Testing Materials, was likely to depart from the methods of oil analysis it had elaborated and adopted. He outlined the development of these institutions and the standard methods of petroleum-testing they had recommended, and spoke of the cordial relations between the Standardisation Committee of the Institution of Petroleum Technologists and these American organisations, from which collaboration he hoped would result an agreed system of nomenclature and specifications of the greatest mutual advantage. Such agreement he considered of much greater value to the two countries having by far the largest interests in petroleum than could be gained by the reincarnation of an International Petroleum Commission.

SOCIETY OF GLASS TECHNOLOGY.

Prior to the meeting held in Stourbridge on March 15, at which Dr. M. W. Travers presided, members visited the works of Messrs. King Bros., Ltd. (Stourbridge), and of Messrs. E. J. and J. Pearson, Ltd., both of which manufacture refractory materials.

Prof. W. E. S. Turner, in reading a paper by himself and Mr. A. Cousen, entitled "Some Notes on the Production of Colourless Glass in Tank Furnaces," said that selenium, generally in the elementary form, and accompanied by cobalt oxide and arsenious oxide, was now commonly used for decolorising. The conditions governing its successful use were not clear, particularly when saltcake was present in the batch. To elucidate these conditions, Mr. Cousen had made a series of melts, and found that the normal bottle-glass batch (sand 1000, limespar 200, soda ash 370 parts) could be decolorised with $\frac{1}{2}$ oz. of selenium and 1-12 oz. of cobalt oxide per 1000 lb. of sand when melted at 1375° C. for 3½ hrs. If 10 parts of soda ash were replaced by an equivalent weight of saltcake, twice as much selenium was needed, and

even four times the amount did not prove excessive, and if 20 and 40 parts of soda ash were replaced, 2 oz. of selenium per 1000 lb. of sand gave good results. The effect was partly due to the solution of iron compounds from the pot by saltcake and partly to the reaction between saltcake and selenium. For successful decolorisation the amount of iron in the glass should not exceed about 0.11 per cent. as ferric oxide. Much less selenium was required for a soda-ash batch if it were introduced as sodium selenite, as the tendency to burn out was checked.

Mr. W. J. Rees then read a paper entitled "A Review of the Preliminary Specifications for Refractory Materials used in the Glass Industry," which referred mainly to the "Provisional Specification for Glass Refractories" published by the Society of Glass Technology in its *Journal* for May, 1919. Observing that so far little use had been made of the "Specifications," Mr. Rees discussed their value and the directions in which they might be amended. The specifications given for silica bricks and cement were satisfactory, but clauses should be inserted to define the maximum true specific gravity and the minimum mechanical strength. The cause of the poor quality of tank blocks, so troublesome to glass manufacturers, was probably to be ascribed to the many types of glass now being produced and the higher temperatures employed. Some blocks were spoilt by improper treatment, and failure might be due to unbalanced glass batches; this subject needed further investigation. In using tank blocks for the first time the furnace should be raised to a high temperature before the glass batch was filled in. Coatings on blocks had been tried, but none was really successful. The most important desiderata of tank blocks were porosity and uniform texture, and it was desirable that the grog should have the same composition as the rest of the blocks, or have approximately the same solubility factor. More information was needed on the solubility of clays in glass. Three methods of testing tank blocks were described, but none was considered to be generally applicable. Further subjects discussed were the trouble experienced with the spouts and needles of automatic machinery, the use of raw pot-clays and grog, and the comparative behaviour of silicious and aluminous clay.

THE INSTITUTE OF CHEMISTRY.

A meeting of the Huddersfield Section was held on March 15. Dr. H. H. Hodgson presided, and Dr. J. Bruce gave an address on the new scheme of training in chemistry drawn up by the Institute in co-operation with the Board of Education.

The scheme, which referred to a grade lower than that of Associate, was long overdue, as there had been no uniform standard since the Board of Education examinations were discontinued. The examination standard set up for full-time students was lower than that required for a degree; for this there was no adequate reason, indeed, the multiplication of examinations was to be deprecated. For part-time courses the regulations suggested an examination standard equal to that for a degree, but that required explanation. However, the standard should be kept as high as possible and the number of certificates reduced to a minimum. The certificates should be regarded as stepping-stones to the Associateship. It was to be hoped that the grouping of the prescribed courses would ensure that part-time education would be of greater value in future. In the preliminary education prescribed, too much importance was attached to chemistry and too little to literary subjects. Critical judgment and power of expression could best be developed in young students by a thorough train-

ing in English; the lack of adequate preliminary education had been the cause of much failure in teaching evening students, and this, it was suggested, should be avoided by reshaping the preliminary work and by raising the age of admission to such courses. At present there was too little facility for transferring evening students to day courses. The efficiency of the evening work could be greatly increased by providing a scholarship scheme.

In the subsequent discussion, Dr. A. E. Everest pointed out the danger of confusing the certificates given under the new scheme with the diplomas of the Institute. He hoped that the Institute would make quite sure that the necessary preliminary education had been obtained, and advised the application of a time limit to the period within which such preliminary training might be dispensed with.

THE CHEMICAL SOCIETY.

The following two papers were read at the meeting held on March 16, Sir James Walker presiding:—"Change of Properties of Substances on Drying": H. B. Baker; and "The Influence of Nitro-groups on the Reactivity of Substituents in the Benzene Nucleus. Part VI. The Elimination of Halogen during the Reduction of Halogenated Nitro-Compounds": H. Burton and J. Kenner.

Prof. Baker's communication was of exceptional interest. The significance of the work cannot perhaps be fully realised yet. It would appear, however, that it will necessitate the recasting of some chemical theories and the revision of many physical constants. The author's work on chemical reaction, or as is generally the case, the absence of reaction, between dry substances is well known; it is a field of investigation which he has occupied almost alone.

Many years ago he showed that drying had marked influence in raising the boiling-points of nitrogen trioxide and tetroxide. His communication at this meeting extends these observations. He has dried various liquids, after careful purification, by sealing them up with phosphorus pentoxide for periods of six, nine or more years. After such treatment all the liquids showed a large rise in boiling-point, *e.g.*, the b.pt. of ether rose to 83°C ., and that of mercury to 420° — 425°C . Various liquids, after such treatment, exhibited marked differences in the rate at which they reverted to the normal boiling-point (as we know it) when exposed to moist or ordinary air. Thus benzene (normal b.pt. about 80.3°) for which a b.pt. well over 100°C . was found reverted very slowly, and only sank to 80.3° after one month's exposure to air. For benzene (dry) two boiling-points were found, *viz.*, 106° and 118° . If the dried sample of benzene boiled at 106° , it did so gently, but if it rose to 118° before boiling ebullition was violent. Even shaking up with water did not cause the change to normal to take place quickly; it was found possible to boil water through an unaltered benzene layer. An experiment was shown in which dried benzene boiled at 116° .

The vapour pressures of dried liquids were found to be lower than the normal, and drying was also found to have an influence on the melting-point, *e.g.*, the m.pt. of sulphur, after drying for six years, rose from 112.5° to 117.5° . No change, however, was found in specific gravity within the limits of 1 in 10,000.

The author's explanation of these phenomena is that association or polymerisation takes place in complete absence of water vapour. To test this surface-tension experiments were tried. Bromine has normally a factor of association of 1.34; the author found, for his dried sample, 1.99. Similarly, the figure for benzene was found to be 3.39 instead

of 1.28. Incidentally it was pointed out that the normal figure used in calculating association by surface tension, *viz.*, 2.12, was too low, as it was based upon the unwarranted assumption that there is no association in the vapour state.

SOCIETY OF DYERS AND COLOURISTS.

At a meeting of the Manchester Section held on March 17, Prof. E. Knecht read a paper giving the results of work which he had carried out in collaboration with Mr. F. P. Thompson on some properties of oxidised cellulose. It was shown that when bleached cotton was oxidised with acid permanganate in increasing but definite amounts, the resulting oxidised celluloses possessed a reducing power proportionate to the degree of oxidation, but only up to a certain point. That oxidised cellulose no longer contained the same number of hydroxyl groups as cellulose was shown by the observation that on nitration it took up under similar conditions considerably less nitric acid. Acid permanganate acted much less energetically on fully-nitrated cotton than on ordinary cotton.

At the conclusion of his paper Prof. Knecht announced that he had succeeded, in collaboration with Mr. C. A. Hatton, in isolating the nitrogenous cell-content of the cotton fibre. This substance, which constituted somewhat over 1 per cent. by weight of the unbleached cotton fibre, was albuminoid in character. Further study was in progress.

In a paper on "A New Protective Agent for Animal Fibres," Mr. Alfred Edge described a substance which was not only capable of protecting wool and silk from the injurious action of alkali in ordinary washing and scouring operations, but made it possible to dye cotton with sulphide colours in mixed fabrics consisting of cotton and wool.

PERSONALIA.

Sir Ernest Rutherford has accepted the nomination of the Council of the British Association for the Advancement of Science to serve as its president in the year 1923—1924.

The Senate of the University of London has appointed Dr. C. A. Lovatt Evans to the University chair of physiology, tenable at St. Bartholomew's Hospital Medical College.

Mr. William Russell has recently retired after 40 years' service as a teacher of chemistry, first in the Birmingham and Midland Institute, and subsequently in the Birmingham Municipal Technical School.

Mr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, Pa., has been elected a member of the committee of the American Section of this Society, in succession to the late Prof. C. Baskerville.

Mr. F. F. Renwick is to leave shortly for the United States to take up a position with the Du Pont de Nemours Co., of Parlin, N.J., and has consequently resigned his office as vice-president of the Royal Photographic Society.

Prof. F. Haber has been nominated president of the German Chemical Society for 1922-23; Prof. W. Böttger has been appointed honorary ordinary professor of analytical chemistry in the University of Leipzig; and Prof. W. Nernst has entered upon his duties as president of the Physikalisch-Technische Reichsanstalt in Berlin, in succession to Prof. Warburg.

The Thomas Hawksley Gold Medal of the Institution of Mechanical Engineers has been awarded to Prof. E. G. Coker for a paper written in conjunction with Dr. K. C. Chakko and Mr. M. S. Ahmed on "Contact Pressures and Stresses."

Dr. Arthur Lapworth, professor of organic chemistry in the University of Manchester, has been appointed to succeed Prof. H. B. Dixon as Sir Samuel Hall professor of chemistry and director of the University chemical laboratories. Prof. Lapworth will take up his new duties at the beginning of the autumn session.

Mr. Leonard Sumner has been elected president of the Institute of Metals. Prof. H. S. Hele-Shaw president of the Institution of Mechanical Engineers, and Mr. W. L. F. Wastell president of the Royal Photographic Society. Sir Frank Dyson, Astronomer Royal, is the new president of the Optical Society.

Prof. A. Coppadoro, professor of general chemistry in the University of Padua, has been appointed to the chair of chemistry in the Polytechnic, Milan. Prof. V. Zunino has been appointed director of the Royal Technical Institute, and Dr. P. Taresi director of the municipal chemical laboratory at Savona.

The Hon. Jacques Bureau, who has been appointed Minister of Customs and Excise in the new Canadian Government, takes a great interest in chemical industry, and it will be remembered that he spoke on this subject at a luncheon held in connexion with the Annual Meeting of this Society in Montreal last year. The Hon. W. S. Fielding, who retains the portfolio for Finance in the new Government, introduced a preferential tariff for British manufactures in the Laurier administration, and it is expected that the preferential duties will be extended under the new régime.

We regret to note the death, on March 11, of Dr. A. D. Waller, professor of physiology in the University of London, at the age of 55 years.

Dr. W. B. Bottomley, late professor of botany in King's College, London, died on March 25, aged 58 years. Prof. Bottomley carried out extensive researches on nitrogen-fixing organisms in the soil and on the effects of organic growth-promoting substances (auximones) as accessory food factors for plants.

We also record the death of Dr. J. T. Merz, of Newcastle-on-Tyne, in his 83rd year. For many years Dr. Merz served as technical manager to the Tharsis Copper Co. in the works at Birmingham, Glasgow, Hebburn-on-Tyne, and in South Wales, and was also manager of the Blyden Chemical Works. He was one of the pioneers of the electrical industry, helping to found the Newcastle-upon-Tyne Electric Supply Co., an accomplished mathematician, and a writer on philosophical subjects.

Dr. H. Schaumann, a well-known investigator of accessory food factors (vitamins), has recently died in Geneva.

A. Richard Akerman, formerly professor of metallurgy in the Technical High School, Stockholm, and recently chairman of the Stora Kopparbergs Bergslags A.-B., died on February 23, aged 84 years.

The following deaths are announced from Germany:—Dr. Th. Liebisch, professor *emeritus* of mineralogy and petrography in the University of Berlin, aged 69 years; Prof. Emil Hehn, director of the Kaiser-Wilhelm Institut für Metallforschung, Berlin, in his 55th year; and Dr. Alex. Naumann, professor *emeritus* of chemistry in the University of Giessen, at the age of 84 years.

NEWS AND NOTES.

FRANCE.

Third International Conference of Pure and Applied Chemistry.—The Fédération Nationale des Associations de Chimie de France announces that the next International Conference will be held in Lyons from June 27 to July 2 next, the arrangements being in charge of a local committee, of which Prof. Grignard is chairman. The Conference will open on Tuesday, June 27, with a reception of the delegates by the Municipality of Lyons, and the next day will be devoted to meetings of the Council, delegates, and committees, followed by an afternoon tea given by the President of the International Union. On the mornings of June 29 and 30 the committees will meet again and in the afternoons of those days visits will be paid to the local silk-conditioning house, tanneries, and various other works. On July 1 there will be a council meeting and a general meeting of the delegates, followed in the evening by a banquet to be given by the Lyons Chamber of Commerce. In addition to the meetings reserved to the delegates, two special meetings have been organised for technical men in the Lyons district, to be addressed, respectively, by M. Louis Lumière and Prof. J. Perrin. A trip down the Rhone, arranged for Sunday, July 2, will bring the delegates to the neighbourhood of Marseille, where they will be invited to take part in the congress organised by the Société de Chimie Industrielle (*cf. i.*).

Société de Chimie Industrielle.—The second congress of this Society is being organised by a local committee presided over by M. A. Gardavi, administrative director of the Cie. Générale des Produits Chimiques du Midi, and will be held in Marseilles from Sunday, July 2, to Friday, July 7, under the patronage of numerous local people, industrial firms and Chambers of Commerce. Special attention is to be given to the resources—mineral, plant and animal—of the French colonies, and to fats, soap, etc. These subjects, so important to the industries of Marseilles, will also be treated and illustrated at the Colonial Exhibition, to be held at the same time. The programme of the congress is announced as follows:—

July 2, 9 p.m. Reception by the local committee. July 3. Morning: Formal opening; conference; visit to the Technical Institute. Evening: Sectional meetings; conference; private gala. July 4. Morning: Sectional meetings. Evening: Visit to the Colonial Exhibition, technical addresses in the various halls, etc. July 5. Morning: Sectional meetings. Evening: Meeting of presidents and secretaries; general report; formal meeting of closure; conference; banquet. On July 6 and 7 visits will be paid to the harbour works of Marseilles and to factories. The sections will meet in rooms and lecture theatres placed at their disposal by the local technical institutes.

Industrial Notes.—*Metallurgy.*—Keen foreign competition will probably soon force a reduction in the prices of French metallurgical products, otherwise many factories will have to close down. As the high tariff is neutralising the advantage due to the depreciated value of the mark, but few German products are now coming into France, so that Great Britain, which is now offering goods at reduced prices and pursuing a "policy of dumping," is left as the chief competitor. To counteract this undercutting of the market, which will probably increase *pari passu* with the appreciation in value of the franc, it is thought more expedient to increase production by amending the law relating to the 8-hour day than further to increase the import duties.

The negotiations for resuscitating the "Comptoir Sidérurgique" are not yet ended. In Belgium the

firms constituting the "Comptoir des Aciéries Belges" are slow in coming to an agreement; and such delay in individual countries is bound to tell against the successful conclusion of an international agreement. Owing to strong protests from Franco-Belgian interests, Germany will probably be excluded from any such international agreement, which would, *ipso facto*, become merely an inter-Allied pact. The advisability of such exclusion is doubtful, as it would probably strengthen Germany's hand by giving her complete freedom of action and enable her to take full advantage of her depreciated exchange.

Much interest has been excited by the recent sale of 750,000 metric tons of Canadian ore to Germany and by the report that this may be followed by a further sale of 2 or 3 million tons. The Canadian ore contains 52–54% Fe, 11% SiO₂, and 6% CaO, whereas French ore contains 35–37% Fe, 15–16% SiO₂, and 7–8% CaO. The price of the former is 18s. 6d. per ton c.i.f. Rotterdam, or 19s. 6d. delivered at Westphalian works; but its greater iron content compensates for its higher price.

General.—The question whether the State is to hand over the Alsatian potash mines to a single company or to several companies has recently come before the Chamber of Deputies. The Government thinks that the mines should be controlled by three companies, and it therefore opposed a suggestion that they should be controlled by the State in the same way as the Saar coalfields. No conclusion was reached and the subject is to be debated more fully at a later date.

The Parliamentary Committee for Commerce proposes to adopt in peace time the method of mobilising industrial and scientific resources which gave such good results during the war, but to organise it in such a way that it could be easily adapted to the requirements of war. Thus the Ministries of War and Marine would issue periodical reports concerning their metallurgical and chemical requirements, so that interested firms would be able to adapt their works accordingly. The aim is to establish a *liaison* between the fighting services and the large producers, and to introduce business methods into these services rather than service methods into industry.

The council appointed to supervise the administration of the French railways is to start its work immediately.

Producers of wine and associated interests have just held a congress, which lasted a full week, to promote the development of the industry, which is among the most important of France, as it employs about 7 million workers, and the glass and cork industries are largely dependent on it. The delegates to the congress were unanimously of opinion that active propaganda should be undertaken in the United States in order to remove the present customs barrier and other restrictions, and that such propaganda should be based on the plea that French wines are unadulterated and of great hygienic and dietetic value.

Mineral Resources of the Ivory Coast.—The geology of this colony has been little studied and gold is the only mineral that has been worked to any extent. The gold-bearing region is apparently very extensive and is probably related to that of the Gold Coast. Prospecting is difficult owing to the need for sinking exploratory shafts, but the veins, situated in lateritic strata, are often rich, and contents of 500 gm. (16·1 oz.) gold per metric ton are not uncommon. The mineral contains bismuth telluride which causes losses in the amalgamation process and makes treatment with chlorine or cyanide almost impossible. Superficial deposits of limonite occur in the laterites but have never been exploited, and no interest has been taken in the aluminium hydrates which are found in places in the laterites

and are sufficiently pure for commercial use.—(*Rev. Prod. Chim.*, Jan. 15, 1922.)

AUSTRALIA.

Metals and Minerals in 1921.—The Imperial Mineral Resources Bureau has received from the High Commissioner of the Commonwealth of Australia particulars relating to the production, etc. of minerals and metals in Australia for the year 1921, as compiled by the Australian Metal Exchange, and the following statement is based thereon. Unless otherwise specified the figures are given in long tons (2240 lb.) :—

	Lead.	Tons.
Production	83,878
Smelter production of pig lead	55,749
Exports of lead (as pig lead and lead bullion)	33,749
Exports of lead in concentrates and ores	6,448
Imports of lead	1,507
Home consumption	9,629

	Zinc.	Tons.
Production	139,460
Smelter production of spelter and zinc	1,681
Exports of zinc (as spelter and zinc)	1,043
Exports of zinc in concentrates and ores	19,616
Imports of zinc	948
Home consumption	4,934

	Silver.	Fine oz.
Production	8,326,006
Refined silver recovered	1,572,878
Exports of silver (bar, ingot and sheet)	2,711,729
Exports of silver in concentrates, ores and matte	726,121
Home consumption	1,359,654

	Gold.	Fine oz.
Production .. .. .	.. .. . (about)	775,000
Exports of gold bullion .. .. .	.. .. .	118
" " " in matte .. .. .	.. .. .	949

	Copper.	Tons.
Electrolytic and refined copper produced	18,600
Exports of refined copper	12,082
Exports of copper in ore, concentrates, blister and matte	34
Home consumption	3,758

	Tin.	Tons.
Refined tin produced	2,985
Exports of refined tin	1,701
Exports of tin in ores and concentrates	5
Imports of tin	65
Home consumption	1,909

	Iron Ore and Pig Iron.	Tons.
Pig iron produced	352,365
Exports of pig iron	2,765
Imports of pig iron	1,423
Home consumption (apparent)	349,600

	Arsenic.	Tons.
Production	978
Exports	2
Home consumption	950

	Coal.	Tons.
Production—(a) Coal	12,788,101
(b) Brown coal	79,224
Exports (exclusive of bunker)	1,592,523
Imports	0,457

	Manganese Ore.	Tons.
Imports	1,503
Exports	16

	EXPORTS.	Tons.
Antimony ore	380
Alumina	1,075
Asbestos	28
Cobalt ore	431
Molybdenite	20
Gypsum	2,187
Wolfram	119
Scheelite	10
Osmiridium	1,977
Platinum	84
Native platinum	363

Alterations in the Patent Law.—The Commonwealth Patents Act, 1921, passed on December 15 last, amends the Principal Act of 1903–1909 by extending the terms of patents from 14 to 16 years and

by limiting the maximum periods for which a patent may be prolonged to 5 or 10 years. In addition provision is made for prolonging the term of a patent when loss or damage has been caused through the war. Applications for patents under the International Convention may in future be made either by the foreign applicants or their legal representatives or assignees. The new Act also applies the Principal Act to the territory of New Guinea from a date to be fixed by proclamation. A copy of the Act may be consulted in the Patent Office Library, 25, Southampton Buildings, London, W.C. 2.

BRITISH INDIA.

Crop Forecasts.—The final forecasts of the crops of sugar-cane and groundnuts for 1921–22, together with the percentage decrease (given in parentheses) as compared with the final forecasts for the previous year, are as follows:—

	Area, Acres.	Yield, Long tons.
Sugar-cane ..	2,381,000 (–7%)	2,592,000 (–3%)*
Groundnuts ..	1,916,000 (–8%)	920,000 (–10%)*†

* Raw sugar (gdr.). † Nuts in shell.

To the figures for sugar-cane should be added an estimated production of 22,000 t. from about 20,000 acres in other parts of British India not included in the main estimate. Owing to lack of rain the weather was unfavourable for sugar-cane at the beginning of the season, but subsequent rains improved the condition of the crop, which is now reported to be generally good. Deficient rainfall is also responsible for the decrease in the groundnut crop.—(*Ind. Tr. J.*, Feb. 23, Mar. 2, 1922.)

SOUTH AFRICA.

The Industrial Value of Maize.—In an article contributed to the January issue of the *South African Journal of Industries*, Mr. J. Burt-Davy states that no crop provides either so great a variety or so large a quantity of different manufactured or commercial products as maize, yet its importance as an industrial raw material is but little realised outside the United States. He draws attention to the varied industrial uses of maize, and gives a list of its products, from which the following items have been abstracted:—

The grain yields maize oil, which is used as a condiment, as a medicine, a rubber filler, and as a source of glycerin and fatty acids; dextrin, gluten, and starches obtained from it could be utilised as sources of dextrose, acetaldehyde, alcohol, glycerin, butyric and acetic acids, acetone, etc. Sugar and alcohol can be obtained from the stalks, which also yield cellulose and by-products from which ethyl alcohol can be made. From the cobs could be manufactured xylose, furfural, acetic acid, cellulose, gum, charcoal, phosphoric acid, and potash (fertilisers). The husks could be used as a source of cellulose, corn silk (*maidis stigmata*), and maizenic acid. Ustilagine (ergot) for medicinal use, could be recovered from the elevator screenings.

UNITED STATES.

The American Chemical Society.—It is anticipated that from 700 to 1000 chemists will attend the meeting of the American Chemical Society to be held in Birmingham, Ala., from April 3 to 7. Prior to the meeting visits are to be paid to industrial plants in Kingsport and Chattanooga, Tenn., and those members who are American citizens and unconnected with the cyanamide industry will be able to inspect the Government cyanamide plant at Muscle Shoals. Excursions to the steel, by-products, coke and other industries in the Birmingham district have also been arranged. Dr. Edgar F. Smith, president, will hand over to the Society dies for the Priestley

Medal, together with funds which have been subscribed for a medal to be awarded biennially for the most distinguished service to chemical science and industry. Dr. Van H. Manning will read a paper on "The Pioneer's Field in Petroleum Research," Dr. Charles L. Reese will discuss "Informational Needs in Science and Technology," and Dr. W. C. Geer will speak on "Recent Developments of the Chemistry of Rubber." One of the avowed purposes of the meeting is to promote the passage of the Reclassification Bill as reported by the Senate Civil Service Committee, providing for higher salaries for scientific men employed by the State.

Potash from Greensands.—Potash from the greensands of New Jersey, Delaware, Maryland and Virginia is soon to appear on the market combined as potassium nitrate, thus giving the preparation a double value as fertiliser. The greensand consists of glauconite, a silicate of potash and iron, with traces of other substances, including phosphates. Caustic soda will be one of the valuable by-products of the process.

Reported Disintegration of Tungsten.—According to the New York correspondent of *The Times* (March 14), Dr. G. Wendt and Mr. C. E. Iron have succeeded in producing helium from tungsten by passing a very powerful electric discharge through an extremely fine wire of the metal, the disintegration being accompanied by a loud explosion, a brilliant flash of light, and an exceedingly high temperature. Authoritative confirmation of this telegraphic report will be awaited with much interest.

Bureau of Mines Laboratory Car.—A laboratory car has recently been purchased for the co-operative work which is being conducted at the Columbus Station of the Bureau of Mines with the four associations for heavy clay products. This is the first laboratory car that the Bureau has equipped, and is similar to the Bureau's rescue cars. It is known as the "Car Holmes" in honour of the first director of the Bureau, and is a Pullman with living accommodation, laboratories, and office facilities for use at all hours. The investigation staff will visit various industrial plants with a threefold purpose: to cut down fuel consumption; shorten the time of burning; and improve the quality of the product. The first trip was made from Columbus to one of the hollow-tile plants of the National Fireproofing Co. at Haddonville, Ohio.

Barytes and Barium Products in 1920.—So great was the demand for barytes for paint manufacture during the year 1920 that sales attained the record total of 228,113 short tons, valued at \$2,142,464, and the average price for the year was \$9.39 per short ton f.o.r. The demand continued until November, when it suddenly ceased. Of the 252,987 t. of crude barytes consumed, 229,443 t. was used in manufacturing barium products, viz., 65,748 t. of ground, refined barytes, 89,373 t. of lithopone, and 20,760 t. of barium chemicals. Manufacture of these products has steadily increased since 1915, when the production of barium chemicals first became important, and although there has been much fluctuation, sales of lithopone have risen by 92 per cent. and of barium chemicals by 135 per cent. since that year. The production of barium chemicals, except lithopone, was as follows in 1920:—Carbonate 7484 t.; chloride 3081 t.; sulphate (blanc fixe) 8046 t.; other barium compounds 2146 t. The total imports, 28,874 t., were greater than in any year since 1915, and it is anticipated that the figure for 1921 will equal if not exceed that for 1914. Most of the foreign ore came from Germany. The separate items were:—Ground barytes 274 t.; lithopone 1714 t.; peroxide 251 t.; sulphate 165 t.; carbonate, precipitated, 476 t.; natural (witherite) 1510 t.; chloride 1595 t.—(*U.S. Geol. Surv.*, Dec. 6, 1921.)

CANADA.

Industrial Notes.—Messrs. Colgate & Co., of New York, manufacturers of soap and toilet preparations, are erecting a factory in Montreal.

The Hamilton Tar Products Co. is erecting a plant at Ottawa for the distillation of tar and the manufacture of tar-products.

The Ontario Potteries Co. is building a plant in Oshawa, Ont., for the manufacture of tableware. The clay is found near Bowmanville, Ontario.

It has been established that good newsprint can be manufactured from jack-pine (*Pinus banksiana*). The jack-pine is found in practically every part of Canada, and besides being very plentiful, grows very rapidly.

The Chippawa power-plant of the Ontario Hydro-Electric Commission at Niagara commenced operations on December 28, last. It is the largest hydro-electric development in America, and was visited last autumn by the British chemists.

Mr. P. D. Reid, president of the Reid Newfoundland Co., has announced that a contract has been negotiated with Messrs. Armstrong, Whitworth and Co., Ltd., to develop the resources of the Humber River Valley, Newfoundland. Under the project, paper mills twice the size of the large Harmsworth plant at Grand Falls, which supplies newsprint to the Northcliffe papers in London, with a capacity of 1,000 t. daily, will be erected. Mr. Reid stated that the contract guarantees the expenditure of \$7,000,000 within two years for the establishment of aluminium works and other industries at Grand Lake and extensive water-power development. Operations are to commence at once.

Minerals.—A Vancouver dispatch reports the discovery of an excellent quality of amber at the Coal-mont Collieries in Nicola Valley, British Columbia.

Platinum is reported to have been found on the Smoky River, B.C., and Red Deer River, near Nevis, Alberta. The former locality was at one time worked for placer gold.

Iron ore, covering an area of six by twelve miles, has been discovered near Grande Prairie, Alberta. The ore contains 47 per cent. of iron, and is situated in the same district as the Ponce Coupe oil-borings.

Le Roi No. 2, Ltd., the only gold-mining company in British Columbia backed by English capital, has arranged to increase its production by adding an oil-flotation equipment to the concentration plant. This company has paid \$1,620,000 in dividends during its existence.

Prospecting in the vicinity of Elk Lake, townships of Yarrow and Morel, Northern Ontario, shows that the iron-ore deposit in the district is approximately four miles wide and eighteen miles long. The belt lies between the silver formations on the south and gold formations on the north. Diamond drilling of the area is to commence this spring.

The extensive deposits of gypsum, situated in Victoria County, Nova Scotia, have been sold to an American syndicate, which will expend about \$250,000 on plant and development. The property contains about 280 million tons of gypsum. The gypsum, like that from Windsor, N.S., and Albert Co., N.B., will be sent by ocean-going vessels to the United States market.

The coal upon the Telkwa river, Northern British Columbia, is being developed and worked. There is a considerable number of seams, some being 18 ft. and of excellent quality. Samples from some of the seams, known as "blacksmith coal," gave an average analysis of moisture 1.8%, volatile combustible matter 31.0%, fixed carbon 63.6%, and ash 3.6%. The coal-beds lie about seven miles from the main line of the Grand Trunk Pacific Railway, and coal is being shipped to Prince Rupert and other points in competition with the coals from Vancouver Island and Alberta.

GENERAL.

Are there Vitamins?—Under this somewhat sensational heading an article has recently appeared in *The Times* which at first sight gives the impression that the work of Capt. Elliott, M.P., and Dr. Orr, with which it deals, has seriously shaken the position of the supporters of the vitamin theory. Actually this work forms a contribution to the large and ever-increasing volume of literature dealing with the nature and causes of rickets. The origin of this disease is still obscure and it seems probable that much further work will be required before it is as completely elucidated as that of scurvy or beri-beri. There seems to be little doubt, and it is generally admitted, that the presence or absence of Vitamin A is not the only factor concerned, but that several others are involved in the production of the disease, and almost every paper which appears suggests some new solution of the difficulty.

The discussion on the function of Vitamin A in the causation of rickets does not, however, in any way affect the mass of work upon which the conception of vitamins is founded. In particular it has been abundantly proved that mineral deficiencies are not responsible for the effects caused by lack of vitamins, and it is obvious that the answer to the question of *The Times'* Medical Correspondent is an emphatic affirmative.

"Coal and Smoke."—In an article reprinted from the *Edinburgh Review* of October, 1921 (Longmans, Green and Co., ls.) Prof. J. W. Cobb, of the University of Leeds, examines the problem of utilising the national coal resources from a broad standpoint. After surveying other sources of energy, he says we are left with coal as the fuel upon which the country must depend, and this is the basic principle upon which he investigates the problem of coal conservation.

The largest proportion of the nation's coal is of a bituminous character, and although such coals are valuable for steam-raising, gas-making, coke-making and low-temperature carbonisation, they yield smoky fuels in the domestic fire. The remarkable influence the coal strike had upon the atmosphere of the large towns is commented upon, and the opinion expressed that in the great bulk of industrial operations the emission of smoke is unnecessary. The statement of Mr. D. Brownlie that great economies are still possible in steam-raising plants is emphasised, and in the author's opinion such economies could best be effected by inspectors acting not merely as detectives but as friendly advisors. This suggestion appears to be a most valuable one and worthy of much closer attention.

In continuing his argument, Prof. Cobb lays emphasis upon the impossibility of preventing the emission of smoke from certain industrial furnaces, and shows that manufacturers will have to enter into this subject in a public-spirited manner, since they must not expect any direct pecuniary gain. The merits of low-temperature carbonisation are reviewed and the fact established that the thermal and monetary costs of carbonisation have to be incurred whether ordinary coke or semi-coke is the end-product, and that it is difficult to see how coke can carry the increased financial burden associated with low-temperature carbonisation.

Considering the economic advantages derived from the Gas Regulations Act of 1920, it is suggested that this Act will encourage gas undertakings to modify and develop their processes in a manner which would not be possible if any restriction other than that of calorific value were placed upon the quality of the gas. Prof. Cobb is a strong advocate of complete freedom for the gas industry in connexion with the carbon-monoxide content of coal gas, and is of the opinion that if the amount of carbon monoxide be limited by any modification of

the present regulations the results will be detrimental to the economies which can be introduced under the Act. He examines the arguments against restricting the amount of carbon monoxide, and considers that the dangers from this gas are compensated for by the improved health of the general community from the wider use of gas in place of solid fuel evolving smoke. The risks of carbon monoxide may be largely overcome by informing the public of the dangers of gas-escapes, making these impossible by good gas-fittings, ensuring that coal gas has a characteristic odour, and improving the ventilation in houses so as to minimise danger when leaks occur. He adds that these precautions should be and are being taken to a great extent at the present time. It is important that all connected with the gas industry should enter into this subject with very great caution, as until the general public has received and assimilated the information mentioned by Prof. Cobb it is not desirable for the percentage of carbon monoxide to be increased unduly. The many cases of gas poisonings which have been recorded in the Press recently show that the public has not yet received this information. In connexion with this subject attention may be drawn to two articles in the *Manchester Guardian* of February 23 and 24 in which a well-informed special correspondent strongly advocates the restriction of carbon monoxide in coal gas to 12-15 per cent.

The World's Production of Cane Sugar.—An unofficial estimate places the world's production of cane sugar in 1921-22 at 10,915,000 t., or 925,000 t. less than in the previous year. The reduction is anticipated because the Cuban crop is expected to fall to 3 million tons (later advices give 3½ mill. t.) and because 1,250,000 t. from last year's crop is left in the island. Other estimated yields are:—Java (May-November) 1,620,000 t.; Hawaii 465,180 t.; Porto Rico 415,000 t.; Mauritius 180,000 t.; Philippine Islands 276,000 t.; and Formosa 348,000 t.—(*Ind. Tr. J.*, Feb. 23, 1922.)

The Dutch Sugar-Beet Crop.—It is estimated that the Dutch beet crop for 1921-22 will amount to 2,311,185 metric tons (m. ton=0·98421 long ton), or 14 tons per acre, as compared with 2,105,000 t. worked in 1920-21. At the thirteen factories of the Central Sugar Co. (the Dutch sugar combine) the sugar content of the beets has averaged 16·97 per cent. (17·76 per cent. at the Sas-van-Gent factory and 17·55 per cent. at the co-operative factories). Prices per metric ton of beets have varied between 47s. 3d. and 61s. 3d. in Utrecht and between 54s. and 61s. 3d. in Zeeland (with the gulden at 1s. 9d.). In 1920-21 the output of sugar was 288,451 t. and the consumption of raw sugar 208,324 t. During the year ended August 31, 1921, exports were 3683 t. raw beet sugar, 127,989 t. refined beet sugar, 375 t. other sugar, and imports were 24,826 t. raw (mostly cane) sugar, 13,303 t. refined cane sugar, and 3259 t. other sugar.—(*U.S. Com. Rep.*, Jan. 16, 1922.)

The Swedish Iron and Steel Industry in 1921.—The annual report issued by the Swedish Iron Works Commercial Association shows that great depression ruled in the Swedish iron and steel industry during 1921. Most of the iron-ore mines and steelworks were either closed down or on short time, and at the end of the year only 22 out of 133 blast furnaces, 37 out of 201 Lancashire hearths, and 15 out of 18 Martin furnaces were working. The output of iron and steel products was as follows, the percentage of the 1913 output being given in parentheses:—Pig-iron 308,600 tons (42%); blooms, bars and ingots 230,900 t. (31%); rolled and forged iron and steel 122,900 t. (30%). Exports were only 147,600 t. (502,600 t. in 1913), and sales in the home market were very small owing to foreign competition, despite greatly reduced prices. Swedish

manufacturers were undersold by competitors in countries which were favoured by a depreciated exchange.—(*Bd. of Trade J.*, Feb. 23, 1922.)

The Spanish Metal Industry.—According to a report published by the Ministry of Fomento, Spain ranks as the second largest producer of copper and lead in the world. British interests control 90 per cent. of the Spanish production of copper, which is obtained mainly from the Rio Tinto mines; and French capital controls the Penarroya lead industry. Spain is the largest producer of mercury and all the production is exported under contract with the Rothschilds. Production of nickel and chromium ores and similar minerals is insignificant. Raw materials are converted into finished products only on a small scale, but there are eight firms employing over 1000 men and 13 others employing over 500. As an illustration of the undeveloped state of the Spanish mineral industry, it was recently stated that only 19,903 acres of iron-ore deposits were exploited in 1919 out of a total of 753,350 acres.—(*U.S. Com. Rep.*, Jan. 23, 1922.)

The Swiss Dye Industry in 1921.—According to the report of the Swiss Credit Bank, the retrograde movement in the Swiss dye industry continued throughout the year. Sales decreased by one-third in quantity and by almost one-fifth in value, and imports of raw materials declined still more sharply. During most of the year the factories worked only four days a week and had to discharge men as well as reduce wages slightly. The causes of the decline were the depression in the textile industries, the unfavourable exchange, and protective tariffs in the chief consuming countries. Especially harmful have been the deliveries of German "reparation" dyestuffs. Prices are falling and the large stocks of old and costly raw materials are disappearing rapidly.

The Leather Industry in Soviet Russia.—The number of tanneries working in Soviet Russia at the end of June, 1921, was 1775 and the number of employees 88,300, including 59,000 skilled workers and 8600 officials. During the first six months of 1921 the number of hides tanned was 3,451,000, compared with 2,700,000 in the corresponding period of 1920; this figure, however, only represented 88 per cent. of the anticipated production. Since the decree was issued permitting private persons to operate industrial establishments, many tanneries, all of which had been "nationalised," have been leased by the Government for private operation, but Government will continue to work some of the larger tanneries in order to supply its own requirements and to regulate prices.—(*U.S. Com. Rep.*, Jan. 23, 1922.)

Dye Manufacture in Brazil.—Two plants in San Paulo and one in Rio de Janeiro are producing dyes for the local textile industry, and it is stated that most success has been attained with sulphur blacks. Conditions are not so favourable for the manufacture of colours that have a smaller sale or are more expensive to produce. All the necessary intermediates are imported. Vegetable dyes have been made in a wide range of shades, but never on a commercial scale, and it seems improbable that any industry of this nature will prosper in the near future.—(*U.S. Com. Rep.*, Dec. 19, 1921.)

Agricultural Industries in Jamaica.—The report of the Jamaican Department of Agriculture for 1920 states that the year was a very bad one for agriculture. Owing to the drought the sugar crop was small, and exports of sugar decreased to 36,664 tons, despite a large increase in cultivation and factory capacity. With the present capacity, including factories under erection, an annual export of 60,000 t. sugar could be maintained if prices were sufficiently remunerative. Notwithstanding the drought and the spread of disease, the value of

the exports of bananas reached £1,630,000; it is believed that the disease is propagated by using banana refuse from the markets for mulching healthy fields. Technical difficulties in the preparation of "evaporated" bananas have been overcome and the decline in exports was due to a shortage of fruit. At present the tendency is to extend the area under bananas rather than that under sugar. Exports of coconuts increased by 4 million nuts, but the export of copra remained at 700 tons; the total value of coconuts and copra exported rose by £56,000 to £356,000. The logwood industry was prosperous, the export value being £700,000, but subsequently the demand almost ceased owing to the depression in the woollen and leather industries. Exports of cacao were lower by 30 per cent., and the coffee crop was only one-half of the average; high prices were realised in both cases. The closure of the American market badly affected the citrus growers, but trade with Canada was expected to improve as a result of the trade agreement between Canada and the West Indies. Orange oil sold at very high prices and brought in a revenue of £90,000, or about twice that received for the fruit. Cotton-growing did not prosper, and the small revival recorded in 1919 proved to be transitory. Pimento was in demand, but owing to short supply the export declined by one-half.

Vanillin has been prepared from pimento-leaf oil in the Government laboratory, and the possibilities of the new industry are being explored. The yield of pimento-leaf oil varies considerably with the season and the origin of the leaves. Experimental shipments of the oil have been sold in London and the United States at 10s. per lb., but the market was not sufficiently good to justify large forward contracts and the erection of a factory to extract the oil on a large scale (*cf. J.*, 1921, 13 n; 1922, 69 n). Sisal hemp is now exported, two small factories are actively engaged, and large areas have been planted in the May Pen district and in the Government plantation at Lititz; manufacturing at Lititz was due to be started early in 1921. Despite the drop in the price of fibre it is considered that, with efficient extraction, even the present low prices would leave a margin of profit. Hides continued in fair demand and goat-skins were sold to the value of £30,000.

British Association Reprints.—With reference to the note on this subject in our last issue (p. 102 n), we are asked to state that these reprints may be obtained either from the office of the Association (Burlington House, Piccadilly, W. 1) or through booksellers. In the former case prepayment is desired, and the published price includes the cost of postage.

GOVERNMENT ORDERS AND NOTICES.

SAFEGUARDING OF INDUSTRIES ACT.—The Board of Trade has issued a summary of recent decisions of the Referee relating to the inclusion and exclusion of certain substances in the lists of articles chargeable with duty under Part I of the Act, as follows:—

Properly excluded:—Calcium carbide.

Properly included:—Planimeters and integrators (planimeter type); calculating cylinders; mucic acid.

Improperly included:—Lactose "R"; cream of tartar, tartaric acid, citric acid.

Lactose "R," cream of tartar, tartaric and citric acids have accordingly been withdrawn from the lists, as from March 25.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Statistics of Production and Wages.

Replying to Mr. Hurd, Mr. Baldwin said he was aware that official statistics in the United States showed that the proportion of wages to the total returns of industry in that country had risen from 68·7 per cent. in 1909 to 77·3 per cent. in 1918, leaving 23·7 per cent. for management, rentals, royalties, etc., as compared with 31·3 per cent. in 1909. Similar figures could not be prepared for this country as no census of wages had been taken since the partial census in 1906 and no census of production since the war.—(Mar. 6.)

Oil- Wells in Great Britain.

Mr. Bridgeman, answering Mr. Doyle, said that the oil-well at Hardstoft, Derbyshire, was the only one producing at present and the production for the six months ending December 31, 1921, was 78 tons. No oil had been sold since October, 1920, as it was difficult to dispose of small quantities of crude oil. So far the evidence obtained was not sufficiently conclusive to enable the commercial possibilities of oil-boring in this country to be gauged. The Government had decided not to introduce legislation to give the Crown further powers or rights in respect of petroleum in addition to those already laid down in the Petroleum Production Act, and the powers provided in that Act would only be exercised to prevent indiscriminate or improper boring.—(Mar. 6.)

Home Grown Sugar, Ltd.

In reply to Mr. Mosley, Major Barnston said that the first accounts of this company were made up to March 31, 1921, and as no profit was made, the Government paid, in accordance with the guarantee, £91·6 to the company as interest on the shares subscribed by the public.—(Mar. 7.)

Cost of Raising Coal.

Mr. Bridgeman informed Mr. Cairns that whereas the average cost of raising a ton of coal in 1914 was 8s. 9½d., of which 2s. 1½d. represented costs other than wages and royalties, the corresponding figures for the quarter ended September 30, 1921, were 21s. 1d. and 6s. 7d., respectively.—(Mar. 7.)

Mining Industry Act, 1920.

A motion by Mr. S. Walsh that Part II of the Act, relating to the establishment of pit committees, etc. (*cf. J.*, 1920, 240 n) should not cease to have effect was negatived by 141 votes to 99.—(Mar. 7.)

Manufacture of Morphine.

Answering Mr. Gilbert, Mr. Shortt stated that the three firms licensed to manufacture morphine were required to provide adequate supervision, exclude unauthorised persons, keep records of production, etc. The export of British-made morphia (excluding any exported by parcel post) was 81,098 oz. in 1921, and the total amount of morphia licensed for export, including export by post, was 112,681 oz. Morphia was exported to all parts of the world, but over half the export went to France, and more than 5000 oz. each to Belgium, Canada and Sweden.—(Mar. 9.)

Railway Rates.

Mr. Neal, in reply to Mr. D. Graham, said that the increase in railway rates had been reduced from 100 per cent. over the pre-war level to 75 per cent. for certain goods, including coal and coke, raw materials for the iron and steel industry, and lime-

stone for chemical works. The reductions had been granted experimentally for a period of 12 months.—(Mar. 9.)

Colonial Rubber Industry.

Mr. Churchill informed Mr. Carew that the committee appointed to investigate the rubber plantation industry in British Colonies and Protectorates submitted an interim report in November last, as a result of which discussions were proceeding between the colonial authorities in British Malaya and the Dutch East Indies.—(Mar. 13.)

Water-Power Development.

Answering Mr. Perkins, Mr. Baldwin said that at present it was not proposed to introduce legislation to control water-power developments or to constitute a water commission, as suggested by the Water-Power Resources Committee. The Ministry of Health, however, was setting up an inter-departmental committee to co-ordinate the work of the different departments responsible for water interests.—(Mar. 13.)

German Scientific Publications (Reparation Duty).

Replying to Mr. Kiley, Mr. Baldwin stated that periodical publications of German learned societies and other German scientific periodical publications had been exempted from levy of reparation-recovery duty because booksellers required full payments of subscriptions in advance, whereas the levy could only be collected and repayment claimed from the German Government periodically as the publications arrived. It was considered inadvisable to allow any obstacle to hinder the regular receipt from Germany of scientific information.—(Mar. 13.)

Imports of Citrate of Lime.

In answer to Mr. Ormsby-Gore, Sir P. Lloyd-Greame said that the imports of citrate of lime from the British West Indies and Italy in 1921 were 206 and 318 tons, respectively. Citrate used for making citric acid did not come under the Safeguarding of Industries Act.—(Mar. 14.)

Prices of Superphosphate.

Replying to Mr. J. Walton, Major Barnston stated that in February, 1922, the prices of the chief agricultural products were about 80 per cent. above the average of the three years 1911-13, whereas prices of superphosphate were about 70 per cent. above the average of those years. Representations had been made to the Board for a duty of 33½ per cent. to be applied to imported superphosphate, but no *prima facie* case for reference to a committee under Part II. of the Safeguarding of Industries Act had been established.—(Mar. 15.)

Dyestuffs (Import Regulation) Act.

Mr. Baldwin stated, in reply to Col. P. Williams, that certain quantities of woollen and cotton cloth were being exported to the Continent to be dyed or printed. A similar practice prevailed before the war, and there was no evidence that it was carried on more extensively to-day, or that it was due solely or even mainly to the operation of the Dyestuffs Act.—(Mar. 13.)

Mr. Remer moved leave to bring in a Bill to repeal the Act, alleging that it did not provide real protection, that the British Dye industry was inefficient and that the British Dyestuffs Corporation had "charged monstrous prices for very inefficient material." He also asserted that the Act had been very badly administered; licences had been given to men of straw, who had made enormous profits by illicit importation, and traders on the Licensing Committee had obtained information concerning their competitors' business.

In opposing the motion Lt.-Com. Astbury said that as a calico printer he had no difficulty in obtaining all the dyes he wanted both from home and foreign sources; his firm was booked up with orders to the end of the year. The cost of colour on a manufactured piece of 150 yards was only 3 per cent. of the total cost, so that colour was the least item of expenditure in the factory. When agents applied for licences to import dyes, the application was probably not granted at first because the agent desired to get dyes in stock that he thought the consumer might want in the future, with the result that if the dyes were not required they were put on the market and the home producer lost business. It took the biggest German works three years after the discovery of a new dye to put it on the market, and our manufacturers were trying to perfect their colours while trade was slack. Germany was now offering colours that we could produce at prices lower than ours, but was asking extortionate prices for colours that we could not make. If the Act was repealed it was to be feared that eventually we should have to rely solely on enemy countries for dyes. The motion was rejected by 197 votes to 115.—(Mar. 15.)

German "Reparation" Dyes.

Answering various questions, Mr. Baldwin said that, under the Peace Treaty, the Allies were accorded options on the stocks of dyes in Germany at a fixed date and on the output for the five years ending January 1, 1925. The total value of the dyestuffs covered by the provisions of the Treaty could not be estimated because the second option was a continuing one and market prices fluctuated. The fullest use was being made of the provisions and the German obligations had been fully carried out; there was no obligation on the German manufacturers to produce according to the needs of the Allied countries. The quota that could be taken was strictly limited and was allocated between all the Allies, but this country was taking its full share. It was necessary, however, to supplement "reparation" dyes by supplies from other countries. The Central Importing Agency was controlled by the Board of Trade only in so far as it acted as the Board's agent in distributing "reparation" dyes and for this it received a commission of 3½ per cent. The estimated value of the "reparation" dyes handed to the Agency for sale during the year ended December 31, 1921, was £75,000. Dyes delivered to the Agency in the six months ended September 30, 1921, were valued by the German authorities at 12,297,000 paper marks. Statistics were not yet available to show what these dyes realised or the cost of realisation.—(Mar. 13, 20.)

Safeguarding of Industries Act.

Gas Mantles.—The referee decided that certain constituents of gas mantles are dutiable under the Act, but deferred signing an award to enable him to state a case for the High Court at the request of the gas-mantle manufacturers. The responsibility for an early decision does not lie with the Board.—(Mar. 6.)

Tartaric Acid Inquiry.—The names of certain complainant firms were not disclosed at this inquiry, because the Board was satisfied that such disclosure might harm the firms commercially.—(Mar. 6.)

Complaints under Part II.—The remaining applications will be examined as rapidly as possible, but very few of the applicants have furnished sufficient information to enable the Board to consider their complaints.—(Mar. 6.)

Volume of Trade.—Although the money values of imports in 1921 are much below those of 1920, the volume of trade in recent months has shown little,

if any, falling off from that of the previous year. There is no reason therefore why further committees should not be set up under Part II. of the Act.—(Mar. 13.)

Glassware and Gold Leaf Inquiries.—The reports of the committees on glassware and gold leaf have been received and will be presented to Parliament and published in due course.—(Mar. 13.)

Revenue.—The net amount of duty received under the Act during the last three months was £73,200.—(Mar. 15.)

REPORTS.

REPORT ON THE ECONOMIC AND FINANCIAL CONDITIONS IN PARAGUAY, DATED SEPTEMBER, 1921. By F. W. PARIS, H.M. Consul, Asuncion. Pp. 32. Department of Overseas Trade. London: H.M. Stationery Office. 1922. Price 1s. 3d.

Paraguay possesses an excellent climate, a fertile soil and abundant supplies of fine timber, but development has been hindered by lack of labour and bad transport. Quebracho, obtained in the Chaco district, is an important forest product; the export of quebracho logs has declined since the war, and in 1920, 21,061 metric tons of extract and 269 t. of logs were exported. Yerba-maté (Paraguay tea), tobacco and sugar are the most important crops. Under 4000 tons of yerba-maté is produced yearly from forest trees, but when the new plantations come into bearing the production will increase by about 12,000 t. per annum; the chief producing company is British-controlled. Of late the sugar industry has become more important; in 1920 the crop increased by 1295 t. to 3800 t. (from 11,000 acres), and Paraguayan sugar was exported for the first time; this industry also produced 92,180 gallons of industrial and rectified spirit and 141,100 galls. of rum. There are seven factories producing raw sugar but a refinery will probably be needed as the industry develops. Cotton of fine quality is grown, and 432 t. was sold in 1920. The groundnut crop is fairly important; the average annual production is 1100 t., and the oil is consumed locally. Petit-grain oil, obtained from the leaves of the bitter-orange tree, is a staple article of export; the production in 1920 was 71,000 kg. and the average selling price, f.o.b. Asuncion, 27s. per kg. The abundant resources of medicinal, dye and fibre plants remain unexploited.

The extent of the mineral wealth of Paraguay is still largely unknown, but there are large and workable deposits of valuable iron ores. The richest known deposits of magnetic iron ore, hydrated oxides, and brown hematite occur near Ibiéui, Quiquyo, Caapucú and the surrounding districts. Pyrites and manganese dioxide abound and many occurrences of copper are known, but lack of transport has discouraged any serious attempt to develop them. Other minerals include limestone, lithographic stone, marble, granite, porphyry, serpentine and kaolin; only limestone is worked to any extent, but the export of kaolin to the Argentine is being attempted. Salt is obtained at Lambaré. Although coal has not yet been found, there is a cheap and inexhaustible supply of hardwood for fuel. Petroleum is also believed to exist both in Paraguay proper and in the Chaco Territory bordering on Bolivia, but no systematic prospecting has been carried out. Manufacturing industries, chiefly soap, cement, pottery, matches, brewing, are only of local importance.

Exports in 1920 were valued at £3,037,116 (5 gold pesos=£1) and included, besides quebracho products, 198,965 hides and 73·6 metric tons of petit-grain oil. Argentina took 58·5 per cent. of

the exports, France 9·6 and the United States 8·7 per cent. Imports amounted in value to £2,623,701, including chemicals, etc. worth £202,934, glass and china £22,522, and iron and steel worth £702,761. Of the total imports Argentina supplied 38·3 per cent., the United States 23·8 and the United Kingdom 19·8 per cent. Chemicals were supplied chiefly by the United States (47·4%), Argentina (29·5%), and the United Kingdom (4·3%), and the glass and china by Argentina (57·5%), United States (10·2%), and the United Kingdom (6·8%). A large proportion of the imports from Argentina probably consists of British goods, but trade with the United States is growing and Germany is rapidly recovering a hold on the market.

REPORT ON THE COMMERCIAL AND ECONOMIC SITUATION IN THE REPUBLICS OF PANAMA AND COSTA RICA, DATED SEPTEMBER, 1921. By MR. C. GRAHAM, H.M. Chargé d'Affaires, Panama, and MR. F. N. COX, Acting H.M. Consul, San José, respectively. Pp. 36. Department of Overseas Trade. H.M. Stationery Office. 1921. Price 1s.

Panama.—This Republic is comparatively undeveloped and has few industries, but in consequence of the opening of the Panama Canal it may eventually become a distributing centre for neighbouring countries. The principal products are bananas, coconuts, cocoa, timber, etc., and the country is well adapted to the cultivation of practically all tropical crops and to cattle raising, but the lack of roads hampers progress. Were better means of communication and sufficient labour available, Panama could become an important producer of sugar, coffee, cocoa, hardwoods, and tobacco. At present the area of the banana plantations is being reduced owing to the presence of a disease for which no remedy has yet been found, and the coconut industry is suffering from bad trade. Manganese ore has been mined on a small scale by an American company at Mandinga Bay and in the Boqueron Valley. The discovery of copper ore in the province of Los Santos has been announced, but no attempt has yet been made to work it. Petroleum occurs both on the Pacific and Caribbean coasts and two concessions for exploration have been granted to or leased by American firms.

Most of the foreign trade is done with the United States. In 1919 exports were valued at 3,640,453 balboas (balboa=United States gold dollar), and included:—Coconuts \$290,805; medlar gum \$65,759; balata \$99,457; ivory nuts \$91,100; rubber \$14,319; and sarsaparilla \$10,957. Imports, largely textiles and foodstuffs, amounted in value to \$17,092,270. The chief imports from the United Kingdom are alcoholic liquors, textiles, china, perfumery, soap, and paint, but openings could probably be found for earthenware, glass, matches, etc. As the climate is very damp, there is need for special care in packing.

Costa Rica is also a large producer of coffee and bananas, which together represent in value roughly three-quarters of the exports. Other products include various timbers, sugar, hides and skins, gold, silver, and manganese ore. Exports in 1920 were worth £2,563,929 (U.S. 71·1%, U.K. 20·8%), the chief items being:—Sugar 5107 metric tons; coffee 13,998 t.; cacao 2154 t.; gold and silver bullion £200,754; manganese ore 3253 t. In 1920 the value of the imports rose by 127·47 per cent. to £3,386,221, the share of the United States falling from 71·45 to 52·11 per cent. and that of the United Kingdom and Colonies rising from 6·91 to 14·21 per cent. Details of the import trade are not available, but the following goods were obtained from the United Kingdom and Colonies in 1919:—Drugs and chemicals £17,512; soap £17,273; paint £9511; rubber manufactures £9350; perfumes £8231; china and glass £5527, and leather goods £4317.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for
March 9, 16 and 23.)

TARIFF. CUSTOMS. EXCISE.

Austria.—Import licences are granted without special application for certain fuels, essential oils, perfumery, various mineral and coal-tar oils, wares of rubber, glass and pottery, arc-lamp carbons, glue, acetic acid, fats and oils, etc. Export licences are no longer required for charcoal, ceresin, copper sulphate, and certain preparations of iodine. An export licence is still required for silver nitrate.

British India.—The Budget contains proposals for increasing the customs duties on iron manufactures, matches, sugar, petroleum, etc.

Cyprus.—The importation of dangerous drugs, including opium, morphine, cocaine, ecgonine, diamorphine and salts and preparations of these drugs, is prohibited, except by permission of the chief medical officer.

Egypt.—Sugar may not be imported except under licence.

France.—Export prohibitions have been withdrawn from hides, skins, animal (not fish) fats, edible fats, oilseeds, fecula, sugar, molasses, charcoal, organic manures, phosphate rock, dephosphorisation slag, fertilisers, ammonium sulphate, sodium nitrate, calcium nitrate and cyanamide.

France and Algeria.—Lignite and paraffin wax and liquid or solid tanning extracts will be admitted at the old (i.e., smaller) "General" tariff rates of duty if from certain parts of the British Empire.

Greece.—Up to 600 metric tons of fuel alcohol may be imported until April 30.

Italy.—Export licences are no longer required for earthy residues of metallic mercury, lactic flour, and lard. Petroleum and other liquid fuels may now be exported freely.

Kedah.—An export duty at the rate of 2½ per cent. *ad valorem* has been applied to coconuts, copra, betel-nuts, and pepper.

Kelantan.—New import duties are applicable to imported matches.

Madagascar.—Increased consumption duties have been applied to soap, pottery, glassware, iron and steel, etc., but not to gas-mantles.

Mexico.—The export duty on white and "ozo negro" beans has been reduced from 5 to 2 centavos per kg. The increase of 50 per cent. in the import duties on drugs, pharmaceutical specialities, and chemical products not specially mentioned (in the tariff) has been withdrawn. The stamp tax on alcohol has been decreased by one-half.

Morocco.—Export prohibitions affect sugar, wood charcoal, vegetable oils, and vegetable tanning extracts.

New Zealand.—Articles affected by the depreciated-currency surtax include rubber tyres, glassware, fertilisers, perfumery, certain classes of paper, tinsplate, and various manufactures of iron.

Norway.—Stamp taxes have been imposed on cocoa preparations and chocolate made in, or imported into, Norway.

Nyasaland.—Except when authorised by the Government, opium, morphine, ecgonine, diamorphine and their salts or preparations containing not less than 0.2 per cent. of any of these drugs may not be imported.

Poland.—Import prohibitions affect all sugar, sweetened cocoa, certain artificial sweetening substances (of sweetness greater than that of cane sugar) used in the manufacture of saccharin, patented artificial sweetening substances, scents.

Rumania.—The export régime is to be maintained until further notice.

South Africa.—Recent customs decisions affect egg albumin and ultramarine blue; the latter is free of duty when imported for manufacturing purposes.

Spain: Colonies in the Gulf of Guinea.—A list of new customs duties is given in the issue for March 23.

Switzerland.—Import licences are required for certain wares of glass, and calcined and crystallised soda, but not for liquid or solid caustic soda.

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Canada	Lump manganese (80 per cent.), iron	271
"	Perfumes, soap	275
"	Tanning extracts, sodium sulphide, oxalic acid, Glauber's salts	7931/E.D./S.C.2
"	Tin, lead	8137/E.D./S.C.2
"	Tanning extracts, Glauber's salts, sodium sulphide, copper sulphate, industrial chemicals generally	†
Fed. Malay States ..	Paint	301
South Africa	Paint, white lead, disinfectants, Soap, grease, oils	331
Belgium	Pharmaceutical products, perfumery	279
"	Rubber tyres	307
"	Zinc, lead, tin, copper, zinc white, dry colours, scrap metals	333
Denmark	Industrial chemicals, chemical products, drugs, dyes, materials for breweries and distilleries	336
France	Products for the soap and candle industries	280
"	Copper sulphate, raw materials for the metallurgical industry	308
French West Africa ..	Portland cement (tender for) ..	14749/F.W.
Greece	Tinplate, galvanised sheets ..	282
Holland	Tinplate	286
Hungary	Chemicals, colours, coal-tar products	283
Norway	Copra, linseed oil	314
Spain	Tinplate, metal tubes	283
Sweden	Potassium bichromate, soda, Glauber's salts, chloride of lime, green and blue vitriol, sulphur, soft soap, glue, china clay, etc.	347
Switzerland	Vegetable oils, industrial raw materials	348
Turkey	Sugar, oils, fats, hides and skins	318
Egypt	Paper (tender for)	S.S.G./Red, 39-2.
"	Coal, oils for soap makers, tinplate, copper plates, corrugated iron sheets	323
United States	Linseed oil	14356 F.W./S.C.2.
"	Drugs, oils, essential oils ..	322
"	Firebricks	14083 F.W./S.C.
"	Sodium cyanide, prussiate of soda, calcium chloride, soda ash	14579 F.W./S.C.2.
Peru	Cement, glass, tiles	5590 F.L./S.C. 2.

* No. 412/20/7/1051, Official Secretary, Commonwealth of Australia, Australia House, Strand, W.C. 2.

† Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

TRADE NOTES.

BRITISH.

British Industries Fair, Birmingham Section.—The attendance at the Birmingham Section of the British Industries Fair, which was held concurrently with the London section, was fairly satisfactory, and as much business was transacted as could be expected in the present condition of industry. Although the exhibits of chemicals were centred in London, several stands at Castle Bromwich were of interest to chemists. The exhibits generally were of a high standard.

The Supremoil Stove and Burner Co., Ltd. showed an interesting range of portable paraffin pressure-stoves which are very adaptable—both flame and temperature can be regulated—and are suited for use in laboratories not fitted with the usual heating appliances. Both burners and stoves are made in patterns varying from small portable sizes to those suitable for heating muffles, kitchen ranges, etc. A comprehensive collection of apparatus and appliances for the general testing of metals was shown by the Industrial Research Laboratory of the Birmingham Gas Department. The non-inflammable cellulose of the British Cellulose and Chemical Manufacturing Company provided an interesting display, the material, known as "Celastoid," being shown in the form of sheets, rods, tubes, with a wide range of colour; and the various applications of industrial collodions in the arts and manufactures were illustrated by the well-known products of Necol Industrial Collodions, Ltd. On the stand of the International Electrolytic Plant Co., of Chester, was a series of cells of varying capacity for the production of pure hydrogen and oxygen by the electrolysis of water, the smallest size being capable of producing from 10 to 100 cu. ft. of gas per hour. The small semi-portable 1·5 h.p. oil-engine exhibited by Petters, Ltd., was worth examination by those requiring a small power-plant for laboratory or works.

An interesting exhibit was provided by the Damard Lacquer Co. consisting of brass, copper, and silver articles coated with the well-known "Damarda" lacquers, which should be especially suitable for protecting the fittings of laboratory and chemical works against corrosive fumes. A comprehensive collection of chemicals and plant for the electroplating industry was displayed by W. Cannings and Co., Ltd., and the Hoekley Chemical Co. Various types of weighing, measuring and counting machines suitable for chemical works were exhibited by W. and T. Avery, Ltd. Special mention should be made of Messrs. Avery's secret weighing machine, which should be useful for compounding secret mixtures, as it can be adjusted to deliver definite weights, then locked and sealed, so that the operator does not know the weights of material used.

Sierra Leone in 1920.—Exports from this colony in 1920 increased in value from £2,101,569 to £2,949,380, owing to the high prices of palm products and kola nuts. Among the exports were:—Ginger 1432 tons; kola nuts 3677 t.; palm kernels 50,425 t.; palm oil 2066 t.; and piassava 657 t. Of the exports 53·2 per cent. went to the United Kingdom, 17·1 per cent. to British West African possessions and 1·5 per cent. to the United States. The average value f.o.b. of palm kernels has risen from £7·89 in 1901 to £27·79 per ton in 1920, and that of palm oil from £11·87 to £59·63 per ton in the same period; the values for 1919 and 1920 were, however, abnormal and not likely to recur. The imports were valued at £3,518,748 (£2,123,334 in 1919), and 72·1 per cent. came from the United Kingdom, and 14·88 per cent. from the United

States, as compared with 64·7 and 25·1 per cent., respectively, in 1919.

The planting of coconuts was encouraged, and groundnuts imported from French Guinea were planted to check the parasitic disease infecting the native plants. Cacao is still grown in the south of the Southern Province, but elsewhere the soil is unsuitable. Reports on local products such as sisal, oil-palm fibre, cotton and native fibres were furnished by the Imperial Institute. Exportation of gum copal was again prohibited to prevent over-tapping in the Kessowa reserve; the native method of tapping has been found to be the best. Results of scientific interest were recorded by the Geological Survey, but with the exception of small deposits of iron ore and scattered deposits of clay, there were no discoveries of economic value.—(*Col. Rep.-Ann.*, No. 1090, 1921.)

FOREIGN.

Trade of the United States in 1921.—The value of the import trade of the United States in 1921 declined by \$2,769,456,087 to \$2,509,025,403, of which 31 per cent. represented raw materials, 14 per cent. semi-manufactures and 25 per cent. manufactures. Exports of domestic produce decreased in value by \$3,701,457,091 to \$4,379,023,730 (raw materials 22 , semi-manufactures 8 , manufactures 31). This general decline in values was not due to a smaller volume of trade, but to lower prices. The following statistics show the value and distribution of the trade in glass and pottery during 1921:—

	Imports.	Increase over 1920	Exports.	Decrease.
	\$	%	\$	%
Glass and glassware ..	10,691,505	+26	14,437,162	—35
Pottery ..	12,525,438	+8	6,279,567	—93

Bottles, carboys, jars, etc. are the chief articles exported by the U.S. glass industry, and firebricks the chief export of the pottery industry. The imports of pottery included decorated earthenware from England valued at \$3,012,329 and decorated chinaware from Japan worth \$3,121,765. Rubber exports during the year were valued at \$30,786,277, of which over one-half represented tyres and 13 per cent. belting.—(*U.S. Com. Rep.*, Jan. 30, 1922.)

Increased Prices of Nitrogenous Fertilisers in Germany.—The Nitrogen Syndicate has raised the price of nitrogen fertilisers, as from February 8, to correspond with the increased prices of coal. The new prices per kilogram of nitrogen for material in bulk are as follows:—Sulphate of ammonia, undried and unground, 29·80 marks; dried and ground, 30·60 mk.; sodium nitrate, 36 mk.; other nitrates, 29·80 mk.; calcium cyanamide, 26·50 mk. On this basis and assuming £1=1000 mk., the cost of ammonium sulphate (20 per cent. N) and sodium nitrate (15 per cent. N) would be roughly 11s. 9d. and 10s. 8d. per long ton, respectively.—(*Chem. Ind.*, Feb. 20, 1922.)

Foreign Capital in the German Tanning Industry.—Although German control of the Gerb- und Farbstoffwerke Renner was protected by preference shares with tenfold voting power, the company was absorbed by the English company formerly associated with it, the Forestal Land and Timber Co., and this has been followed by the absorption of the Rheinische Gerbstoff- und Farbbolzenextraktfabrik Gebr. Müller by the anglicised Renner company, a majority of shares having been acquired by the Renner Co. in Hamburg. The capital of the Rheinische company is to be raised by an additional 3 million marks to 6 million mk., and the new shares are to be issued to old shareholders at 120 per cent. The directors of this company did not control a sufficient number of preference shares to prevent the undertaking coming under foreign control.

REVIEWS.

ISOTOPES. By F. W. ASTON. Pp. viii.+152.
(London: Edward Arnold and Co. 1922.) Price
9s. net.

We, as chemists, are so vitally interested in the phenomena of isotopic elements that the publication of Dr. Aston's book is an event of importance. The approach to the new knowledge has been by methods which may fairly be characterised as "physical" and is therefore less understood by chemists than it deserves to be, but the writer feels strongly that there is urgent need for chemists now to play their part in the study of isotopes by "chemical" methods, and therefore especially welcomes this book as a thoroughly sound and attractive exposition of the subject. It gives an exact and fairly complete account of the history of the discovery of isotopes, of the methods hitherto used to detect heterogeneity in "elements," of the theories now current in explanation of the observed phenomena, and of the work done in the partial separation of the isotopes of neon, chlorine, and mercury. Great care has evidently been exercised in the production of the book both by the author and the publisher: it is well written in a clear, eminently readable style, it has very numerous references to the original literature, and is closely up to date, containing indeed important results as yet unpublished elsewhere; it is well printed, the diagrams and plates, especially the plates of mass-spectra, are good, and it appears to be entirely free from errors or misprints.

The main feature of the book is a very full account (46 pp.) of the author's mass-spectrograph and the work done therewith upon some 25 elements, and of some work by Dempster and Thomson upon a few other elements, the whole serving to show that of 29 elements investigated, 16 are mixtures of two or more isotopes. The experimental work is detailed in a way which enables the reader to evaluate intelligently the weight of the evidence for the existence of isotopes in the several cases.

The early chapters (42 pp.) contain a less detailed but adequate account of the events which led to the recognition of isotopes: first, among radioactive elements, with the result that the isotopes of lead were discovered and the now well-known variation in the atomic weight of lead from different sources was established; and secondly, in the case of neon, by Sir J. J. Thomson's parabola-method of positive-ray analysis. Dr. Aston, in his preface, disarms the obvious criticism that his treatment of the radioactive isotopes is inadequate to their intrinsic importance: he justly says they merit and should have a book to themselves. What he gives is sufficient for his purpose, and we should be grateful that he has found space to refer to Hevesey's very interesting work, based upon the isotopic character of radium-D and ordinary lead, which has given us, *inter alia*, something like direct proof of the ionic hypothesis.

Following the statement of experimental results is an explanation and discussion (36 pp.) of the electrical theories of matter, the present conceptions of the relations of isotopes based upon them, and the available evidence on the spectra of isotopic elements.

A concluding chapter (12 pp.) deals with the aspect of the matter of deepest interest to chemists, the separation of isotopes. Dr. Aston discusses the theoretical possibilities of separation and the positive, though tantalisingly small, results that have been attained with chlorine and mercury, and one feels that the separation and purification of materials being really a task which requires the chemist's technique, we as chemists are to blame that there is in this matter so little to report. Any excuse we may have had for lack of knowledge of this new and mainly physical experimental work

is now invalidated, because the book under review is good enough (and cheap enough, as books go nowadays) to deserve a place on every chemist's shelves, and should, in the writer's opinion, be a material factor in causing increased activity in this important field of research.

H. V. A. BRISCOE.

SOAPS AND PROTEINS: THEIR COLLOID CHEMISTRY IN THEORY AND PRACTICE. By MARTIN H. FISCHER with the collaboration of G. D. McLAUGHLIN and MARIAN C. HOOKER. Pp. ix+272. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1921.) Price 24s. net.

AN INTRODUCTION TO THE PHYSICS AND CHEMISTRY OF COLLOIDS. By EMIL HATSCHEK. Fourth edition, entirely rewritten and enlarged. Pp. 172. (London: J. and A. Churchill. 1922.) Price 7s. 6d. net.

The first of these books is not an ordinary one; it is an elaborate presentation of a large number of qualitative observations for much of which room was not found in scientific journals. Most of the work is devoted to soap and the author's conception of lyophilic colloids and soap boiling. A short chapter at the end contains some parallel experiments with globulin and gelatin and the application of the author's theories to medicine.

The experimental material consists of pictures of over 1300 test-tubes, beakers and bottles containing a large variety of soap solutions with and without admixtures. Most of these are also described in two or three words each, in tables, whilst comparisons are drawn in the text. In addition there are illustrations of soap solutions which have been shaken for 30 seconds at various temperatures and a dozen figures of emulsions and mixtures of fat with alkali.

The value of the book lies in the remarkable range of specimens of soap solutions made up from pure fatty acids and a great variety of bases, solvents and admixtures. There is wealth of observational material for anyone who is interested in soaps or similar colloidal material. A word of warning is here necessary. In spite of the care which has been taken with the illustrations, which are reproduced from photographs, they often do not give a clear idea of the contents of the tubes; even the printed labels thereon are in many cases unreadable. Added to this is the inadequacy and strong bias of the author's technical descriptions. For instance, alcohol in which N/2 sodium acetate has been formed could never be described by a chemist as a "white gel," which is Fischer's complete description, but rather as colourless, feathery, needle-like crystals occupying about half of the clear alcohol solution. Anyone interested will find it necessary to repeat a few of the typical experiments (which is quickly done if pure chemicals are available) and Fischer's material will enable him to choose the solutions which are most likely to be of interest.

The figures would have been of much greater value if to each had been appended some descriptive title and if cross-references to the tables had been given. Indeed, the tables could have been omitted to advantage if the brief descriptions had been printed as marginal notes to the figures. There are numerous inaccuracies in the indexes, and some of the references do not contain the matter ascribed to them.

Fischer's main thesis is that "solutions" of the higher soaps are emulsions, either of liquid in liquid, or of liquid in a solid; and that at ordinary temperatures the continuous medium is hydrated soap, not aqueous solution. Aqueous solutions, whether of soap or of salts, exist here only in the form of fine emulsified droplets within the con-

tinuous soap phase. Such a soap system may be liquid, or solid (jelly or curd). Heating or dilution, or addition of sufficient salt, will bring about a reversal of phases, so that the aqueous solution now becomes the continuous medium and the soap goes into colloidal dispersion, or true solution, or is segregated and "salts out."

In order to maintain his point of view, which is done with many inconsistencies and contradictions in detail, and without tying it down to concrete illustrations, Fischer has found it necessary to ignore much of the experimental work on soap solutions. His conceptions are irreconcilable with the conductivity measurements which have been made by a large number of investigators in different countries. For instance, the supposed reversal of phases, which is assumed to occur when a true soap jelly is formed, does not accord with the fact that the conductivity is quantitatively unaltered during such gelatinisation. Further, the structure assumed for concentrated curds of the higher soaps of the saturated and unsaturated fatty acids at low temperatures are certainly not those which have been so clearly observed under the ultramicroscope and in which, so far from reversal of phases being observed on warming, one fibre after another is seen to go into solution until all are gone.

The book is written in a delightfully easy and fluent style, although it is marred by wholesale disparagement of most previous workers and of chemists and physical chemists as a class, which hardly becomes so eminent a professor of physiology.

Mr. Hatschek's little book is a balanced *résumé*, unencumbered with detail, of the state of our knowledge of colloidal matter at the present time. In the fourth edition, which is entirely rewritten and is double the size of that of 1913, Mr. Hatschek has again succeeded in producing a surprisingly thorough and fresh account of the subject. In spite of the brevity of treatment the book is very suggestive and stimulates to further reading and experiment.

The author puts forward Ostwald's classification of colloids into suspensoid and emulsoid in such a way as to imply that their characteristic properties are explicable on the assumption that the particles really are solid and liquid respectively. Although he mentions on p. 30 that these two classes do not quite coincide with the descriptions lyophobic and lyophilic, he does not make it clear that there are a number of substances which do not behave in accordance with Ostwald's postulate. For instance, the sols of mercury, in which the particles are presumably liquid, nevertheless show the typical behaviour of suspensoids. Furthermore, the assumption that the colloidal particles of an emulsoid are merely finely-divided liquids does not easily fit in with recent work on the structure of the gels which they form. The author shows on p. 130 that most probably "there is a linking of the elements of the disperse phase into some continuous structure, probably largely developed in one dimension." This is not the way in which liquid drops coalesce or aggregate.

Among minor points, the cardioid ultramicroscope might have been mentioned on p. 23 on account of its twenty-fold more intense illumination, as well as the possibility of using it at temperatures up to the boiling point.

In the discussion of periodic precipitation in gels, one of the aspects of the subject in which the author is an acknowledged master, it would have been of interest to have found a comment upon the experiments of A. E. Koenig (J. Phys. Chem., 24, 1920, 473), who obtains similar rings of ammonium chloride when dry ammonia and hydrochloric acid gases diffuse towards each other through a long tube filled with air, that is in the total absence of a gel.

JAMES W. MCBAIN.

PATENTS AND CHEMICAL RESEARCH. By HAROLD E. POTTS. Pp. 198. (Liverpool: The University Press, 1921.) Price 8s. 6d. net.

The important rôle which patents can play either in helping or hindering the development of a chemical industry, became particularly apparent during the renaissance in British chemical industry which followed the outbreak of the great war. It was realised that widespread and skilful use of the British patent system had materially assisted the foreigner in checking the development of the industry in this country. The Patents and Designs Act, 1919, was an attempt, *inter alia*, to deal with this situation.

Many of those who find themselves suddenly in possession of an invention have little or no idea of the operation of our Patent Law, and much of the criticism of the latter is due to a lack of appreciation of the fact that it is intended, as far as possible, to hold the balance fairly between the inventor, who needs encouragement, not only to invent but also to disclose his invention, on the one hand, and the public, whose rights of manufacturing and trading must not be unduly interfered with, on the other.

The author, in the book under review, seeks to educate those who engage in chemical research, and those who direct our chemical industry. A short general account of patent procedure is provided, in which the author describes how patents are obtained and used, and deals with the respective functions of the Patent Office and the High Court. The fourth chapter is mainly and properly devoted to an explanation of the paramount necessity for adequate and accurate disclosure of the invention; on which necessity too much emphasis cannot be laid. Mr. Potts rightly points out that not only must the specification contain an accurate and complete description of the method of carrying out the process, but also that the inventor, in his desire to prevent infringement by the use of "chemical equivalents," must be careful not to claim any reagent which might be shown to be unsuitable. Other chapters deal with the necessity of foreseeing, and, as far as possible, guarding against infringement when drafting the specification, with the validity of patents, and with the scope to be aimed at in the claims. All these matters are dealt with from the point of view of their relation to chemical inventions, and there are many detailed references to decided cases on chemical patents. These portions of the book will be found useful and instructive by those engaged in chemical research or industry. A useful chapter on Patents in Foreign Countries is also provided.

In Chapter I. Mr. Potts boldly hazards an answer to the question of whether a chemical process should be protected by a patent, or kept as secret as possible, and here we decline to follow him. The question: "Is it worth while to apply for a patent for this?" is one of the most difficult questions for patent agents, of whom Mr. Potts is one, to answer, and the difficulty is greatest of all when the invention is a chemical one. Apart from questions of the legal interpretation of claims, it is often relatively easy to determine whether one mechanical device is a copy of another, but it is often difficult or impossible to determine whether a chemical substance has been prepared by a patented process or not. The disadvantage of having to disclose his invention, coupled with the difficulty of proving infringement, is one which requires most careful consideration in each case. Mr. Potts points out these difficulties, but dismisses them in favour of patenting, provided a sufficiently bold and energetic policy be adopted, with a view to creating what he calls a favourable "patent situation." We are not as sanguine as the author of being able to detect infringement of a chemical

patent, by analysis of the product, and, moreover, the disclosure of the process may enable others so to modify it as to avoid the scope of the patent, especially as the doctrine of equivalents, as Mr. Potts rightly points out in Chapter VI., cannot be relied on. There are many cases in which the inventor may conscientiously be advised to seek protection, but such advice should only be given after a very careful consideration, not only of the process and the product, but also of the attendant circumstances of the trade. No general answer on this question should be attempted.

Mr. Potts misses no opportunity of advising inventors to seek the closest co-operation with their patent agents. The book loses much in dignity from these repeated exhortations, particularly as the name of the author's firm and the address of its offices are printed in the Preface.

FRANK B. DEHN.

SYNTHETIC TANNINS: THEIR SYNTHESIS, INDUSTRIAL PRODUCTION AND APPLICATION. By GEORG GRASSER. Translated by F. G. A. ENNA. Pp. vi+113. (London: Crosby Lockwood and Son, 1922.) Price 12s. net.

Dr. Grasser, in his preface, explains that he obtained his insight into the technology of synthetic tannins while working at the B.A.S.F. and later, during the war, as technical consultant to the Austrian Hide and Leather Commission. The production of synthetic tannins is classified under two main headings: (1) the synthesis of the most simple tannin (*c.g.*, the tannin of galls) from hydroxybenzoic acid, and (2) the production of chemical substances which have nothing in common with true tannins, but which behave like true tannins in contact with pelt and have practical value as they can be manufactured on a commercial scale. The first class is, at present, of purely scientific interest. There are also a number of cases of pseudo-tannins, *e.g.*, formaldehyde, from which the yield of leather is so low that it is hardly possible to speak of them as tannins in the ordinary sense of the word.

The first section of the book consists of a historical account of researches on the constitution and synthesis of natural tannins and allied bodies under the headings of (1) Tannin, (2) Digallic Acid, (3) Ellagic Acid, and (4) Depsides. This is followed by an account of processes adapted for the synthesis of tanning matters of the second class in which, among others, are described the processes of sulphonation, condensation of phenols, naphthalene derivatives, anthracene derivatives, and bodies of the di- and tri-phenylmethane group. It is noted that dihydric aromatic alcohols combine with sulphuric acid and condense without the agency of formaldehyde, yielding products of tanning power. A short account of the tanning effect of mixtures with natural products is then given, followed by methods of examining tanning materials. Under the latter heading a detailed account of the official method of tanning analysis formulated by the I.A.L.T.C. is given. As this method is well known to be useless for the analysis of synthetic tannins it is difficult to see what purpose is served by its inclusion other than that of increasing the bulk of a rather slim volume. The author states that the only methods of examining synthetic tannins are a test tannage on pelt and a solubilising test on vegetable tannins.

Part II describes the industrial production and application of synthetic tannins. The types examined are those best known in Germany, namely *Neradol D* (dicrosylvanedisulphonic acid), *Neradol N* (dinaphthylmethanedisulphonic acid), and *Ordoval G*, the formaldehyde condensation-product of higher hydrocarbons, mainly retenes. The condensation of free phenolsulphonic acid is described and also that of the same acid when partly

or wholly neutralised. The reactions of *Neradol D* have been studied by the author and are given at length under the headings of electro-chemical behaviour, influence of salts and acids on tanning effect, phlobaphene dissolving power, and action of strong and weak solutions on pelt. *Neradol D* is very sensitive towards iron and alkalis and a caution is given against its use in cement tan pits. A brief note of combination tannages of *Neradol* with chrome alum and oil is given and all the methods at present known of testing leather partly or wholly tanned with this material. Finally are described the different methods of condensation as applied to phenol sulphonic acid, these methods comprising heating *in vacuo* and the use, as condensing agents, of sulphur chloride, phosphorus compounds, aldehydes and glycerols.

The book is remarkably free from misprints and is not, like so many works of its class, largely made up from a compilation of patent specifications. The large amount of original and hitherto unpublished work of the author, included in Part II, as well as the absence of any other book dealing with this subject, should ensure a wide circulation for Dr. Grasser's book among the ever-increasing number of manufacturers and users of synthetic tannins.

DOUGLAS J. LAW.

DIE METHODEN DER ORGANISCHEN CHEMIE (WEYLS METHODEN). Produced by J. HOUWEN with Collaborators. Second edition. Volume I. General. Pp. xxvi+1121. (Leipzig: Georg Thieme, 1921.) Price, bound, 450 marks.

The very substantial volume under review is eminently symptomatic of Teutonic thoroughness and of the steady development which organic chemistry continues to show. Here are set out, in copious detail, every conceivable method by which the organic chemist may practise his craft, each section being presented by an expert in the particular set of operations under consideration. These operations are in no sense preparative; they deal with estimation of the elements which are commonly encountered, with gravimetric and volumetric analysis as applied to organic compounds, with drying, cooling, filtration and washing, with precipitation, distillation and sublimation, with determination of melting-point, boiling-point, molecular weight, solubility, rotatory power, refractive index, heat of reaction, flash-point, viscosity, and with all the subordinate procedure associated with them.

Some conception of the comprehensive treatment characterising the work may be gained from the statement that 75 pages are devoted to distillation, 34 to drying, 47 to determination of melting-point and 173 to the qualitative recognition of elements or to their quantitative estimation. If the presence of 730 illustrations does tend, at times, to suggest an apparatus dealer's catalogue (without prices), it certainly enables the reader clearly to visualise what he is going to do before he proceeds to do it. It will probably astonish most of us to find that there are so many practical variations of the most familiar experimental exercises, and it is significant of the rapid growth undergone by the organic branch in recent years to find that, amongst the numerous foot-note references to current literature, the vast majority relate to publications dating from the beginning of the twentieth century. Very useful sections are those dealing with micro-analysis applied to the estimation of carbon, hydrogen and nitrogen, and with the qualitative recognition of common substances by micro-sublimation, whilst the concluding 50 pages, offering guidance in deciding upon the class to which a colouring matter belongs, although presenting the subject in a very condensed form, will doubtless be appreciated by many readers.

M. O. FORSTER.

OBITUARY.

BENJAMIN MOORE.

The death of Prof. Benjamin Moore at the premature age of 55 deprives physiology and biochemistry of one of its most distinguished exponents. He was educated at Queen's College, Belfast, and his chemistry was acquired from the late Prof. Edmund Letts of Belfast. He studied medicine at University College, London, and was for several years assistant to Prof. Sharpey Schafer there. From University College he became professor of physiology in the Medical School of Yale University but returned to London as lecturer in physiology at Charing Cross Hospital. In 1902 he was appointed to the new chair of biochemistry at Liverpool. He returned to London in 1914 as a member of the staff of the department of physiology at the Medical Research Institute, and in 1920 was elected to the chair of biochemistry at Oxford.

The chief characteristics of Moore were the brilliance and originality of his ideas, and his exuberant energy. He held original views on most biochemical problems and he worked at them at express speed, but his thoughts were continually moving to fresh channels so that there are few points in biochemistry on which he has not touched. Thus he wrote on the antineuritic base in yeast; the nutrition and metabolism of marine animals, in which he showed that an animal might increase its fat-content during inanition and inactivity, though only for a short period until its carbohydrate became exhausted. On photosynthesis he wrote much and found that inorganic iron salts in colloidal solution can transform the energy of sunlight into chemical energy of organic compounds. He showed that organic matter could be synthesised from inorganic colloidal uranic and ferric hydroxides in very dilute solution: the colloid acted as a catalyst for light energy, converting it into chemical energy.

In food questions Moore found much interest; he demonstrated that the bleaching of flour with nitrogen peroxide altered both fats and proteins by nitrating them. He also showed that algæ fixed nitrogen in the summer time, and his new facts at least suggested that the popular "ozone" of fresh air is nitrogen peroxide formed in the atmosphere by ultra-violet rays.

During the war he conducted, amongst other activities, an inquiry into TNT-poisoning in the laboratory and factory which led to more effective protective methods being adopted. Prof. Moore wrote much on medico-sociological questions, and in his book "The Dawn of the Health Age," he strongly advocated a Ministry of Health, a suggestion which he lived to see fulfilled.

He was elected a Fellow of the Royal Society in 1912, and obtained many other distinctions. He was an ideal colleague, the best of friends, extremely modest but enthusiastic to a degree in his work and for his ideals. He was one of the few physiologists who understood early the significance of biochemistry, and has left behind his mark on that science.

W. E. DIXON.

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PRELIMINARY REPORT ON THE MINERAL PRODUCTION OF CANADA DURING 1921. *Dominion Bureau of Statistics, Canada. Mining, Metallurgical and Chemical Branch.* (Ottawa: F. A. Acland. 1922.)

DESIGN OF ATMOSPHERIC GAS BURNERS. By W. M. BERRY, I. V. BRUMBAUGH, G. F. MOULTON, and G. B. SHAWN. *Bureau of Standards. Technologic Paper.* No. 193. Pp. 62. (Washington: Government Printing Office. 1921.) Price 15 cents.

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PETROLEUM LAWS OF ALL AMERICA. By J. W. THOMPSON. Price 40 cents.

OIL-CAMP SANITATION. By C. P. BOWIE. Price 10 cents.

COKE-OVEN ACCIDENTS IN THE UNITED STATES DURING 1920. By W. W. ADAMS. Price 5 cents.

THE DETERMINATION OF OXIDES OF NITROGEN. By V. C. ALLISON, W. L. PARKER, and G. W. JONES. Price 5 cents.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES DURING 1920. By W. W. ADAMS. Price 5 cents.

INVESTIGATIONS OF ZIRCONIUM WITH ESPECIAL REFERENCE TO THE METAL AND OXIDE. *HISTORICAL REVIEW AND BIBLIOGRAPHY.* By J. W. MARDEN and M. N. RICH. Price 25 cents.

THE PRODUCTION OF PRECIOUS STONES FOR THE YEAR 1920. Pp. 31. THE PRODUCTION OF PLATINUM FOR THE YEAR 1920. Pp. 19. By G. F. KUNZ. *Reprints from Mineral Industry.* Vol. XXIX. (New York and London: McGraw-Hill Book Co., Inc. 1921.)

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GOLD, SILVER, COPPER, LEAD AND ZINC IN IDAHO AND WASHINGTON IN 1920. By C. N. GERRY.

GOLD, SILVER, COPPER, LEAD AND ZINC IN ARIZONA IN 1920. By V. C. HEIKES.

COAL-SMOKE ABATEMENT.

The movement for the abatement of the coal-smoke evil has been given a fresh impetus by the recently issued report and recommendations of the Departmental Committee on Smoke Abatement and Noxious Vapours over which Lord Newton presided (*cf. J.*, 1922, 1 R).

The Committee's inquiries, spread over several years, were thorough, and it was unanimously urged that the law should require manufacturers to prevent the emission from their works of smoke in such quantities as to be a nuisance, regardless of the colour of the smoke emitted. At the present time, smoke-pollution is dealt with under the antiquated provisions of the Public Health Act, 1875, which involve proof of the emission of quantities of "black" smoke before a nuisance can be remedied by the local sanitary authority.

The difficulty of establishing that, in a scientific sense, smoke is "black" is obvious, and the law has become a dead letter in many districts. The Committee further recommended that the Ministry of Health should have power to appoint officers to act in an advisory capacity in the manner of inspectors appointed under the Alkali Acts; it further urged that the Ministry should have power to decide what degree and quantity of smoke should be permitted as unavoidable in respect of different trades, and that the County Councils should be charged with the duty of enforcing the law.

In order to emphasise the necessity of prompt Government action to give effect to the recommendations of the Departmental Committee, the Coal Smoke Abatement Society organised a large deputation which waited upon Sir A. Mond, the Minister of Health, on March 20. This deputation was fully representative of local authorities and organisations concerned in public health problems, as well as of the many scientific and technical institutions interested in preventing atmospheric pollution from different points of view. The Chemical Society was specially represented by Prof. H. E. Armstrong and by Mr. E. V. Evans.

Sir Aston Webb, president of the Royal Academy, who introduced the deputation, pointed out that 77 years had elapsed since an official report had been made to the Government on the subject of smoke nuisances, and the statute law was hopelessly inadequate and out of date. Immense strides had been made in scientific knowledge of the chemistry of combustion, and engineering difficulties, which existed when the Public Health Act passed into law in 1875, had now been successfully surmounted. The wasteful methods of consuming coal for the generation of power were notorious and would continue until Parliament intervened. In the meantime, the pollution of the air caused irreparable injury to buildings, works of art and property of all kinds. It injured health, destroyed the amenity of town life and was a demoralising and unnecessary evil. Sir Aston further urged that some attempt should be made to grapple with smoke emitted in connexion with cooking and with the heating of domestic houses.

Sir Napier Shaw, on behalf of the Royal Meteorological Society and the Committee on Atmospheric Pollution, pointed out that investigations had shown that during the night the air of London was clean. The gloom and dirt of day-time were mainly due to coal-smoke, and he was of opinion that two-thirds of the smoke of London came from domestic chimneys. He suggested that a reduction should be made in the rateable value of houses that emitted no smoke.

After the Lord Provost of Glasgow, Mr. Andrew Taylor, Mr. Walter Smith, M.P., and Captain H.

Riall Sankoy had also spoken, Sir Alfred Mond replied in sympathetic terms to the representations of the deputation. It was refreshing to find that the Minister of Health was already an ardent champion of Smoke Abatement. He said that no one who had ever seen the clouds of smoke which hung over the great industrial cities could doubt the importance of the subject. The tolerance of the people towards a terrible state of things was only accounted for by the fact that they had always been accustomed to the nuisance. He had personally taken great interest in the matter and was responsible for making the Black Country much less black than it used to be. There was no reason why factories should emit black smoke, or any other smoke. If they did so it showed bad management, and with mechanical stokers, efficient control and careful watching, not only could smoke be abated but far less coal would be burnt. He deprecated forcing the pace too quickly, as that would only wreck any measure he might introduce. More propaganda was required, and it was necessary that he should ask himself how far he could proceed with legislation or administration to improve matters. The Ministry had made a start, for it had already appointed competent advisers with a view to advising manufacturers as well as local authorities. He was carefully considering the report of Lord Newton's Committee in order to see to what extent it would be possible to adopt the machinery recommended.

It is understood that the Coal Smoke Abatement Society is preparing for early introduction into Parliament a Bill to give effect to the proposals of the Departmental Committee.

CHEMISTS AND THEIR WORK: PRESENT TENDENCIES.*

FRED. J. HAMBLY.

Prior to 1914 civilised countries were content to accept with indifference the localisation of certain chemical and other manufactures in particular countries. On account of the adaptability of the plant required for the production of synthetic organic compounds, including dyestuffs and pharmaceuticals, to the manufacture of explosives and material for chemical warfare, no one country can in future be allowed to monopolise such manufactures, as it is now realised that such a monopoly is potentially as dangerous as one for the manufacture of ordnance and explosives. If the demand exists, it is comparatively easy to manufacture any chemical product on a scale sufficiently large to meet a demand vastly in excess of any peace-time requirements, but the question at once arises as to how to find a market for such products. In commercial chemistry to-day the position is that whereas the world demand for certain chemicals is less rather than greater than it was in 1913, Germany, France, England, Switzerland, Scandinavia, the United States, and Canada all possess a superabundance of chemical plant which cannot possibly be used for peace-time requirements.

Another result of our war experience was the demand for chemical engineers to construct and superintend plants, and the overcrowding of our university courses in chemical engineering to the comparative neglect of the courses in pure chemistry and related subjects. This condition can only be temporary, as the progress of industrial

* Chairman's address to the Ottawa Section, November 10, 1921.

chemistry in the future, as in the past, is ultimately dependent upon the study of pure chemistry in its many specialised divisions.

This frequently-discussed relation between pure and applied science is clearly stated by Prof. J. Arthur Thomson in his recent book "Science for Life," from which the following paragraph is taken:—

"The lesson of history is clear: if any really big changes are to come about, it is likely to be through discoveries in pure science, and the priceless people are those who have brains enough to be discoverers of pure science. There is, of course, nothing but good in applying the results and methods of science to immediate difficulties and limitations: the danger is of a false valuation, of ignoring the lesson of history that, even for practical ends, it is theory that pays, and of diverting the real discoverer from the quest of understanding. No question arises as to the rôle of *inventors* who devise some useful application of a new knowledge which the *discoverers* have established, but the danger is letting inventors overshadow discoverers. A thousand people know of Marconi for one who knows on whose shoulders the Italian inventor nimbly and with perfect fairness perched himself. Ten thousand people know of Edison for one who has heard of Willard Gibbs."

In addressing the members of the Society of Chemical Industry, the first object of which is "To promote and advance Applied Chemistry and Chemical Engineering," no apology is offered for emphasising the initial subsidiary importance of applied to pure chemistry, as a glance over the list of Presidents of the Society amply proves that the principle has always been accepted and acted upon by the Society.

Many of us have recently had the privilege of attending, for the first time, an annual meeting of our Society held in Canada, and those who did not have the pleasure of hearing Sir William Pope's address in Montreal have since read it in the *Journal*. From this highly suggestive address I quote the following extracts in relation to this evening's subject: "That the achievements of synthetic organic chemistry by laboratory methods have led chemists to give more attention to these methods than to those taking place all around us in the living animal and plant . . . that the great majority of chemical reactions which take place in living matter occur catalytically in colloidal media. . . . It is impossible to doubt that a vast expansion of organic chemistry will be witnessed by many of us, an expansion which will result from an imitation of the gently-effected chemical operations carried out in the animal and vegetable creation."

It is also significant that our meeting in Montreal synchronised with that of the British Association in Edinburgh, and the subject selected by Dr. M. O. Forster for his presidential address to the Chemical Section was "The Laboratory of the Living Organism," which was followed by a joint discussion in the sections of Chemistry and Physiology "On oxidations and oxidative mechanism in living tissues." A careful reading of the reports of this address and discussion is strongly recommended to all interested in the present trend of chemical research.

Of direct interest to Canadian chemists is the fact that Dr. A. B. Macallum, who for some years past has given his whole energies to the problem of organising scientific research in Canada, has resigned his position as president of the Canadian Research Council to accept and inaugurate a new chair of biochemistry in McGill University.

Recent work in organic, physical, and colloid chemistry is evidently converging upon a more real knowledge of problems which have fascinated chemists since the time, now nearly a century past,

when Wöhler in 1828 synthesised urea from ammonium isocyanate. The magnitude and importance of many of these chemical processes going on all around and within us, is too often lost sight of by many chemists whose specialised work in the laboratory too often obscures the wider vision, which it is the object of our meetings, conventions, and journals to stimulate and promote.

The best known of Nature's synthetic products is one which we all use daily in a state of 99.9 per cent. purity and obtain retail at a pre-war price of about 5 cents per lb. Whilst the extraction of cane sugar from the cane and beet affords a striking example of the methods of applied chemistry, the scientific study of the chemistry of cane and other sugars was rendered possible in 1886 by Emil Fischer's discovery of the sparingly soluble compounds which sugars form with phenylhydrazine. Notwithstanding Fischer's subsequent brilliant investigations of the sugars, how much, or how little, do we yet know as to how the plant produces sugar by the aid of solar energy from carbon dioxide and water, and of the further transformations of these sugars into starch and cellulose?

The cellulose industries, of which the primary products are pulp and paper, are of special interest to Canadian chemists, and recent developments of colloidal chemistry indicate that in this connexion the field is ripe for continued investigation.

A suggestive paper on the "Fundamental Chemistry of Cellulose," by Dr. J. Macdonald, read in September last before the technical section of the British Paper Makers' Association, is worthy of note.

The compounds obtainable by the breaking-down of cellulose, starch, and sugar by the action of ferments are also destined to become of even greater importance in the future. Sooner or later the internal-combustion engine must become dependent upon industrial alcohol for its motive power.

The nature of catalysis is one intimately related to the action of ferments, the enzymes of which are probably closely related to the vitamins, further knowledge of which forms one of the immediately pressing problems of animal nutrition.

In other branches of our science, that of electrochemistry may be mentioned. Whereas important progress has been made during the past thirty years in the utilisation of electrical energy in chemical processes, the conversion of chemical into electrical energy has made but little advance during the past century, but it can scarcely be doubted that the conversion of the potential chemical energy of fuel into electrical energy will be accomplished without passing through the wasteful circuit of the heat-engine.

The applications of discoveries already made may be left to industrial laboratories, which will increase in importance as the passing generation of employers and boards of directors become replaced by men having a wider knowledge of what may be accomplished by laboratory investigation and control. Some of the larger industrial organisations, such as the General Electric Co., and Kodak Co. in the United States, are, as a commercial proposition, carrying on investigations in "pure" science, in addition to those for commercial development of scientific discoveries; but, in general, the main source of research work in "pure" science must be in our Universities, supplemented and aided by Research Institutes maintained by the State.

There is an increasingly wide field before us for research work, but what are the inducements to attract the student entering our universities to take up the science of chemistry as a profession comparable to those in Medicine, Law, or even Dentistry?

The extraordinary feature of our position to-day is that not only in Canada, but also in Great

Britain and the United States the general public does not even know what a chemist is. In Canada the only persons legally entitled to call themselves "chemists" are those qualified under the various provincial Pharmacy Acts to dispense poisons—for example, the Quebec Pharmacy Act, R.S.P.Q., Art. 4999, Sect. 11, defines as follows:—

"The words 'druggist'; 'chemist'; 'apothecary'; 'pharmaceutist'; 'pharmacist'; 'pharmaceutical chemist' or 'dispensing chemist' mean a person having the right to sell and compound drugs and poisons in this province."

Chemists in Ontario have become so discouraged with this aspect of the situation that they have actually formed an association which proposes to abandon the title of "chemist" for that of "chemical engineer," and by association with other branches of the engineering profession to promote legislation in Ontario to make engineering a closed profession. Chemical engineering is an important branch of engineering, but to designate all chemists as chemical engineers is not a solution of the difficulty, and can only result in producing further confusion in the public mind concerning the province of chemistry and the work of the professional chemist.

Instead of attempting to penalise the use of chemical knowledge by other than members of provincial associations of professional chemists, it should be our object to create such an appreciation by the general public of the aims and objects of chemistry, that the services of professional chemists should be sought in many matters in which, at the present time, the possibility of such services possessing any money value is not even recognised. A somewhat analogous position is that now occupied in the commercial world by the chartered accountant. Whereas a common school education gives every person a knowledge of arithmetic sufficient to keep more or less complete records of receipts and expenditures, the conduct of even a small business requires the keeping of accurate books of account and the employment of a person who has made a further study of accounting; but when an authoritative statement of such accounts is required for partners, shareholders, bankers, and others, it is now demanded that such accounts be examined and certified by a chartered accountant, whose special qualifications are certified by a legally incorporated society of accountants. The growing recognition of the importance of scientific accounting has not been obtained by direct legislative action, though it will in all probability be so recognised in the near future.

The history of the Institute of Chemistry of Great Britain and Ireland during the thirty-four years of its existence indicates that the recognition of professional chemistry in Great Britain is proceeding on similar lines. Although founded in 1877, the Institute has not attempted to make chemistry a closed profession, though its qualifications are now recognised by the British Government in connexion with official chemical appointments. In view of the widely-spread relations of chemistry to the arts and manufactures it does not seem possible to restrict the practice of professional chemistry in the same manner as that of Law and Medicine, as the demand for the services of professional chemists can only develop as the paying public becomes educated to its need of such services.

It is therefore difficult to see how the better public recognition of the importance of chemistry and the improvement of the position of the professional chemist can be attained other than by patient and persistent education of the general public. To this end a Press propaganda on the lines so ably advocated by Dr. C. H. Herty, and now carried on by the American Chemical Society, should be definitely organised and systematically promoted by Canadian

chemists, and it is satisfactory to learn that action in this direction is now being considered by the members of our Society in conjunction with the Canadian Institute of Chemistry. Another line of attack should be the extension of the instruction in elementary chemistry and physics given in our schools to the point of making such knowledge a compulsory requirement for the school-leaving certificate, and for entrance to the Universities in any Faculty.

Concurrently with this further education of the public, we as chemists must, by means of our Canadian Institute of Chemistry, set up such a standard of professional education and experience that membership of the Institute shall command public respect upon all matters relating to chemistry, such as, evidence in courts of law, qualifications for government and municipal appointments, and reports upon chemical problems in relation to the industries.

NEWS FROM THE SECTIONS.

BRISTOL AND SOUTH WALES.

At the annual meeting, held on March 16, Mr. Charles J. Waterfall, chairman, addressed the Section on the subject of British scientific societies dealing with chemistry. After referring to the foundation and objects of the Royal Society, the British Association, the Chemical Society, the Pharmaceutical Society, and the Institute of Chemistry, he spoke of the inception of the Society of Chemical Industry and the new development of the formation of Subject Groups. Mr. Waterfall then described the initial steps that had been taken to establish co-ordination between the various societies in the matter of the publication of original communications and abstracts; he deprecated the duplication now existing and deplored the waste of money and the still more important waste of time which it involved.

Speaking on the place of science in the works to-day, he pleaded for consideration of the scientific staff in these days of drastic economy. Before the war we had low national taxation, reasonable rates, cheap food and correlative cheap labour (labour was under-paid), low freights, lower railway rates than to-day, and large investments abroad. To-day brain and sinew were our outstanding assets, the other advantages having disappeared. Taxation was recklessly oppressive. Colonel Armstrong, President of the Federation of British Industries, speaking at Leeds, said that our export trade carried to-day ten times the burden imposed in 1913 and was but one-half of what it was in that year.

Freights, though unremunerative, were still high as compared with pre-war charges, railway rates were excessively high, and bread was still at a famine price. Only by commonsense and effort could trade be re-established. Science in our works was undoubtedly suffering a set-back, the promises of 1919 were not being realised, and yet it was to science that the nation must turn if it was to regain its position in the world of industry.

NEWCASTLE-ON-TYNE.

Dr. J. H. Paterson, retiring chairman of the Section, presided at the annual dinner held in the Refectory of Armstrong College on March 23. The chief guests of the evening were Mr. E. V. Evans; Mr. C. C. Leach, president of the North of England Institute of Mining and Mechanical Engineers; Col. F. R. Simpson, president of the Mining Elec-

trical Engineers; and Mr. E. W. Fraser Smith, secretary of the North-East Coast Institution of Engineers and Shipbuilders.

Mr. Fraser Smith, proposing the toast of the Society and Mr. Evans, said that the value of the Society of Chemical Industry and other technical societies was not sufficiently recognised by the man in the street as one of the greatest factors in education to-day. In his opinion they were as important as the technical colleges, as they carried on the work of education for the men who had gone from the colleges into industry. It would be said that the trade technical Press was also a big factor, but he submitted that a great part of their matter was culled from the doings of such societies as theirs. He paid a tribute to the work of Mr. Evans, who was well known outside the limits of their own Society for his work on fuel problems.

Mr. Evans, replying, assured those present that the Newcastle Section had played and still played a great part in the Society of Chemical Industry; its representatives on the Council and committees had made themselves felt, and the papers read before it were valuable assets to the Transactions. Speaking on the need for a greater revenue from the *Journal*, he expressed the opinion that some means would have to be devised for making an appeal to the men in the chemical industry who had money to spend as well as to works' chemists, and that could be done without lowering in any way the high scientific standard of the *Journal*.

Col. F. R. Simpson proposed the Local Section and its chairman. As a coalowner he was very interested in the question of coal analyses. He was bound to say he found them very funny things, especially when one analysis showed 6 per cent. of ash in Durham smalls and another 14 per cent. The Society was a useful one, and the mining industry and all other industries were finding out that they could not get on without the chemists. He regretted as much as they did that their chairman was leaving the district for London, as it meant that the Section was losing a real asset.

Dr. Paterson, replying, made special reference to the Newcastle Chemical Industry Club, and suggested that its development had been accompanied by a corresponding development of the usefulness of the Society. He was a great believer in extending the social life of the members of technical societies, and the experience of the Newcastle Club had confirmed that view. He hoped to see a great extension of the social side of technical societies in the near future.

MANCHESTER.

A paper on "The Relation between the Chemical Constitution and Antiseptic Action of the Coal-tar Dyestuffs," by Mr. T. H. Fairbrother and Dr. A. Renshaw, was read at the meeting held on March 31.

The authors referred to the intoxications resulting from infective processes as the probable cause of most of the suffering due to disease, and they enumerated the chief diseases for which no curative agents are yet known. They described their investigations on the antiseptic action of various water-soluble dyes in different degrees of dilution, and emphasised the specific action of certain chemical groupings, fourteen common organisms, in addition to living protozoa, being experimented upon.

Strongly basic dyes such as Crystal Violet and Auramine were proved to have a very strong antiseptic action, but others, e.g., patent blues, acid greens, Torquoise Blue and Victoria blues, to have very little. It was also found that certain dyes have definite selective action, and the importance of this discovery was illustrated by the possibility of destroying the protozoa that cause difficulties in the activated-sludge process of sewage purification,

without destroying the useful bacteria; useful dyes, e.g., Nilo blue, a member of the oxazine series, were able to kill the protozoa in dilutions as high as 1 in 20,000 without harming the bacteria. Another dye was found to kill the worm causing the disease filariasis, hitherto considered incurable. Other dyes would kill the causative agents of such diseases as typhoid, dysentery, and anthrax, and when used in dilutions that were harmless to the tissues of the human body they would destroy protozoa. Dyes showing antiseptic action contained one or more amino groups and were molecular dispersoids.

The authors intend to study the application of their results to human beings and animals and also to the treatment of sewage and the sterilisation of water pipes.

OTTAWA

At the February meeting, Mr. F. Hambly, in introducing Colonel Gaudet, referred to the good work he had done in educating the people and the members of the Canadian House of Commons to realise the need of adequate provision for research in the Dominion; and he read a letter from the Hon. J. A. Robb, Minister of Trade and Commerce, expressing his regret at being unable to attend the meeting.

Colonel Gaudet then spoke on the subject of organised industrial research in Germany, and pointed out that the aim of the world should be to reconstruct our economic and social system and to restore as speedily as possible our industries and commerce to the conditions under which they thrived previously to the war. He traced the development of the industrial work carried on by Germany and credited the success of that country to the efficient chemical industry which had been built up prior to the outbreak of hostilities. The speaker outlined in some detail the nature and extent of Germany's domination in the scientific fields and drew practical applications from the instances cited. In conclusion, he made a strong appeal for the establishment of a national research institute in which science would co-operate with agriculture and finance under the most favourable conditions for the solution of national problems.

In moving a hearty vote of thanks to Colonel Gaudet, Dr. Shutt pointed out some of the difficulties in the way of the successful organisation of the Research Institute. He asked particularly that the scientific workers in the Government Service should be kept informed of new developments in the Research Council's field of activities. The motion was seconded by Dr. Alfred Macintyre, who mentioned some further examples of the way in which the German industries had been built up by chemical research.

The meeting then discussed the definitions of chemical terms which had been sent out with the notice of meeting. After an hour's debate satisfactory definitions were arrived at and the thanks of the Section were voted to the committee which had drafted the provisional definitions used as a basis for the discussion. These definitions were given in the last issue (p. 120 n), with the exception of that of "derivative," which was as follows:—

A "derivative" is a chemical compound formed or produced from an elementary substance, or a number of elements united and grouped together, known, or classified as a nuclear compound, by either the addition to, subtraction from, or substitution of an element or elements, or of a nuclear chemical group, or groups, compound, or compounds, to the elementary substance or nuclear compound, by the application, individually or collectively, of physical or chemical means or processes.

GLASGOW.

At the annual business meeting of the Section, held on April 1, the local secretary submitted his report for the past session. In reviewing the work of the year, reference was made to an increase in the membership of the Section, to the success which has attended the holding of meetings of a more informal nature than hitherto, and to the regulations for the admission of student associates. The Section has now a great asset in a number of enthusiastic student associates, and this augurs well for the future welfare of the Society and Section. Mr. MacCallum, the representative of the Section on the Glasgow Chamber of Commerce, submitted his report, and the meeting decided to continue sending a representative to the Chamber.

The new officers and members of committee were elected, Mr. W. Moodie being appointed chairman of the Section, Mr. J. H. Young, vice-chairman, and Prof. J. H. Andrew with Messrs. W. H. Coleman, D. N. McArthur and W. Rintoul to fill vacancies on the committee. Cordial votes of thanks were given to the retiring chairman and to the secretary for their work on behalf of the Section.

Subsequently to the meeting, a smoking concert was held jointly with the Society of Engineers and Shipbuilders and the Local Section of the Institute of Chemistry.

LONDON.

At the meeting held on April 3 in Burlington House, W., Mr. E. V. Evans presiding, a paper entitled "The Influence of Structure on the Combustibility and other Properties of Solid Fuels" by Messrs. E. R. Sutcliffe and Edgar C. Evans was read by the last-named author.

After referring to the scanty earlier literature of the subject describing work carried out in this country and in Germany, the authors defined the combustibility of a fuel as its capacity for combustion in unit time. To secure satisfactory combustion the fuel should be as homogeneous as possible and the lumps of uniform size. With anthracite the latter condition is absolutely essential, but with eaking coal even-sizing is useless and frequent poking is necessary. Dust cannot be easily stored owing to the risk of spontaneous combustion, and it is burnt with difficulty, but it may be utilised by briquetting either with or without binding material. The advantages claimed for the use of briquettes are the loading of 25 per cent. more fuel upon unit area of grate surface, regularity of combustion, absence of clinker, and great intensity of radiant heat.

The combustibility of ordinary fuel is governed largely by the content of volatile matter, but that of coke carbonised at a low temperature depends mainly on its structure. The best results are obtained by using coke of a high density in which the number of cells is very great and the cell-structure continuous; the temperature of carbonisation has but little effect. This type of fuel, which resembles charcoal in structure and combustibility, is prepared by mixing powdered coal with coke breeze, briquetting, and carbonising at a low temperature. When used as boiler-fuel this material produces no smoke, thus allowing increased access of radiant heat to the boiler and rendering the use of an economiser unnecessary. Little improvement has been made in the economical working of blast furnaces during the last forty years; about 20–25 cwt. of coke is required to produce one ton of pig iron, or 16–17 cwt. with a mixture of hard and soft coke, but 12 cwt. of the new fuel should suffice for this purpose.

NOTTINGHAM.

The first lecture under the Sir Jesso Boot Foundation was given at University College, Nottingham, by Prof. S. Kipping, on March 24. The subject was the evolution of chemical industry as shown by the successive developments in the manufacture of sulphuric acid from the Nordhausen distillation process to the latest forms of the contact process.

By means of experiments, lantern-slides and diagrams, the difficulties met with at each stage, as well as the economic stimuli operating in the direction of diminishing costs and increasing production, were clearly brought out. The value of private enterprise, industry and invention were emphasised and the nature of the competition between the chamber and the contact processes was outlined.

EDINBURGH AND EAST OF SCOTLAND.

The annual general meeting of the Section was held in Edinburgh on March 7. Dr. H. E. Watt was re-elected chairman, Mr. W. A. Williams vice-chairman, and Mr. W. T. H. Williamson hon. secretary and treasurer. The last-named submitted a report on the work of the past session which was approved unanimously, after which the chairman, on behalf of the members, made a presentation to Dr. A. Lauder in recognition of his services as secretary and treasurer.

At the sixth ordinary meeting of the session, which was then held, Dr. W. W. Taylor and Mr. R. H. Hopkins opened a discussion on "The Determination of Hydrogen-ion Concentration," the former giving a general theoretical introduction to the subject and then dealing more particularly with the methods of determination by means of the hydrogen electrode. Mr. Hopkins described the method of determination by means of indicators.

THE SAFEGUARDING OF INDUSTRIES ACT.

MUCIC ACID.

On March 23, Mr. Cyril Atkinson heard the complaint of the Grahame Chemical Co., of Liverpool, agent for the International Products Co., of the United States, that mucic acid had been improperly classified as a dutiable article under Part I of the Act.

Mr. T. R. Marshall, representing the company, claimed that mucic acid was a heavy chemical. The American company was making it from larch by the process devised and patented by Prof. Acree which consisted in treating larch sawdust with a hydrolytic agent, oxidising the resulting galactose solution with nitric acid, evaporating and crystallising. The plant was at Eureka, Montana, and had a capacity of 2 tons a day, the present rate of production being about 500 lb. daily. The acid had hitherto been made in relatively very small quantities from lactose, and its price was from 18–19s. per lb., compared with about 1s. per lb. as made by the new process. Owing to these drastic changes in the method of manufacture, the quantity produced, and the selling price, mucic acid could no longer be regarded as a fine chemical. Further, it should be classified with cream of tartar, as it was used for the same purpose, viz., in baking powder; it was also used as a safe food for diabetics. The raw material, larch wood, was not obtainable in this country.

Mr. J. Ronca, for the Board of Trade, stated that the above facts were not known when the list was

drawn up in September, 1921, and the Acree process was not in use at that time. The discovery of a new source of raw material did not necessarily change a fine chemical into a heavy chemical; thorium nitrate was no less a fine chemical because it was made from monazite instead of from thorianite, as it was originally. Up to date only 50 lb. of mucic acid from the Eureka works had been imported into this country. Mucic acid, when the Act came into force, was essentially a research chemical and it figured in the pre-war price lists of Merck and Kahlbaum. The processes of preparation from galactose from lactose and from galactose from larch were fundamentally the same, and the fact that there was no larch in this country was not relevant, for many fine chemicals, *e.g.* platinum salts, were made here from raw materials not found in the United Kingdom. If mucic acid were in future made in Canada, no duty would be levied here on material from that source, as Empire products were specifically excluded from the operation of the Act. Mr. Ronca further stated that the Board of Trade also contended that mucic acid was a synthetic organic chemical, even interpreting that term in what might be called a purely academic sense—a restriction which the Board did not regard as permissible. Galactose, the starting material, could be synthesised through *a-acrose* and sorbitol; there was no doubt that mucic acid was organic; and its production from galactose involved a change in percentage composition and to a certain extent in structure.

In giving his decision, the Referee expressed the opinion that mucic acid could not at the present time be regarded as a heavy chemical; the whole of Mr. Marshall's contentions related to a possible future; a production of 600 t. a year was not sufficient to justify it being taken out of the list of fine chemicals; and it had not yet any real industrial use. At the time the Board prepared the list, there was no option but to regard mucic acid as a fine chemical, and he therefore decided that it was properly included in the list. He was inclined to think, but did not decide, that it was a synthetic organic chemical.

LIQUID SULPHUR DIOXIDE.

The complaint that liquid sulphur dioxide was erroneously excluded from the list was heard on March 24 and 25. The complainants, Messrs. A. Boake, Roberts and Co., Ltd., of Stratford, E., were represented by Mr. E. J. Boake, assisted by Dr. W. P. Joshua, and Mr. J. Ronca conducted the case for the Board of Trade.

Mr. Boake, in contending that liquid sulphur dioxide is a fine chemical, stated that it was a pure product, made in relatively small quantities under continuous skilled supervision, and used extensively as a laboratory agent, in preparing foodstuffs, in the manufacture of dyes, and to a small extent as a refrigerating agent and for purifying water. Although sulphur dioxide used in the manufacture of sulphuric acid by the contact process was very pure (considered apart from the diluent air with which it was mixed), and was not regarded as a fine chemical, it was a gas, and not a marketable commodity. His product was a liquid marketed in a state of great purity (99·8 per cent.), and free from sulphur trioxide, which was not separated from the burner gases in the manufacture of sulphuric acid. The liquefied substance was manufactured in a complicated plant, the present rate of production was 1·0–1·5 tons per day, and there was no comparison between this output and that of sulphuric acid. He did not admit the contention that fine chemicals were always made in non-specialised plant; phosphoric acid and salicylic acid for instance were generally admitted to be typical

fine chemicals, and they were made in specialised plant. Many sulphites were included in the list as fine chemicals, and he suggested that in classifying liquid sulphur dioxide the Board of Trade had associated it too much with sulphuric acid.

Mr. Ronca, though admitting that the quantity of liquid sulphur dioxide indicated by Mr. Boake, when considered alone, tended to show that the substance might be a fine chemical, did not agree that the purity of gas going to the liquefaction-pump was higher (ignoring air) than that of the sulphur dioxide going to the catalyst-chambers in a contact-acid plant. The nature of the plant used in the manufacture and the comparative ease with which the gas was liquefied brought it within the ranks of heavy chemicals. In the preparation of the list, liquid sulphur dioxide was regarded in the same light as liquid chlorine and carbon dioxide and compressed oxygen, all of which were marketed as was sulphur dioxide, in steel cylinders, and all of which were admittedly not fine chemicals.

The Referee gave his decision on April 1, as follows:—

I have had some difficulty in coming to a decision in this case, but after a very careful consideration of Mr. Boake's contentions the conclusion to which I have come is that I cannot hold that liquid sulphur dioxide has been improperly excluded from the list of dutiable substances.

In the contact process for making sulphuric acid the sulphur-dioxide gas coming from the roasting furnace has to be very carefully purified, otherwise the catalytic platinum becomes poisoned. This purification is a matter of difficulty. There is thus produced sulphur dioxide in gaseous form and of considerable purity. It is, however, mixed with air and contains a little sulphur trioxide. These are not impurities for the purpose of the manufacture of sulphuric acid. This sulphur dioxide is not a fine chemical, nor, of course, is the sulphuric acid produced from it. For the purpose of making liquid sulphur dioxide the sulphur-dioxide gas is first freed of any sulphur trioxide that may be present and is then passed into water for the purpose of freeing itself from its diluent air. The water is warmed, the gas comes off free of air and is then dried and compressed. The question is, whether this further purification and treatment, *i.e.*, the getting rid of the sulphur trioxide and the diluent air, has turned a heavy chemical, *viz.*, sulphur-dioxide gas, into a fine chemical. I cannot bring myself to think that it has. The real difficulties of purification have been already overcome in producing sulphur-dioxide gas. I do not think that the elimination of the small quantity of sulphur trioxide present in sulphur-dioxide gas, and the passing of the gas through water, puts the product into a different category. I think that the trade which regards sulphur-dioxide gas and sulphuric acid as heavy would also regard liquid sulphur dioxide as heavy. The classification of a chemical as fine does not depend merely upon the degree of purity attained. Not being satisfied that the substance in question has been improperly excluded from the list of dutiable substances I hold that the complaint fails.

SAFEGUARDING OF INDUSTRIES ACT.—The Board of Trade has received a formal notice of complaint under Section I. (5) of the Act that reagent bottles, hydrometer, museum, specimen and surgical jars, bell-shaped cylindrical measures, and conical measures have been improperly included in the lists of dutiable articles. Persons directly interested in the complaint, which will be heard shortly, should communicate immediately with the Board of Trade, Industries and Manufactures Department, Great George Street, London, S.W. 1.

THE BEET-SUGAR INDUSTRY AT KELHAM, NOTTS.

Value and Practicability of a Home Beet-Sugar Industry.

It is difficult to understand why Great Britain should have depended so long upon supplies of imported sugar while competing industrial nations were actively engaged in developing a home beet-sugar industry. No less than 110 years ago Napoleon, with characteristic foresight, was initiating the industry in France by laying down 75,000 acres to beet and establishing six centres of instruction. Immediately before the war France and the United States each had half a million acres under sugar-beet, Germany had double that quantity, Austria-Hungary, Belgium, Denmark and Holland cultivated it extensively, but Great Britain had only a few thousand acres and one factory, at Cantley in Norfolk, under Anglo-Dutch control!

The capacity of our soil to grow sugar-beet has never been seriously questioned. Trials made at various times in England and Ireland have shown that our climate and soil are favourable (*cf.* A. R. Ling, J., 1912, 452), and the experience of other countries has taught that its cultivation is very advantageous agriculturally, since the deep ploughing essential for sugar-beet cultivation, cleans the soil and improves its fertility. Moreover, a beet-sugar industry employs a considerable amount of country labour during the slack months of winter; it helps to promote rural life and industry; and it is a self-contained enterprise requiring, when established, neither foreign labour nor imported raw materials.

Apart from innate conservatism, the cause of our backwardness in this respect is to be sought in our national proclivity to buy and sell rather than to sow, cultivate and reap; production has been subordinated to exchange, and we have relied upon naval supremacy to safeguard our communications with foreign producers of essential commodities. Unfortunately for us, other nations have arrived to dispute our commercial hegemony, but, fortunately, the war has opened (or did open) our eyes to the danger of dependence upon external sources of supply, so that we have been driven of late seriously to consider the possibility and practicability of increasing production from indigenous raw materials, or from materials that are available within the Empire. The Committee on Empire Sugar, which was appointed by the Society of Chemical Industry, and reported in 1919 (*cf.* J., 1919, 279 n, 303 r), did notable work in this connexion. Of the 40 million cwt. of sugar we imported in the year before the war only 2 millions came from the Dominions Overseas, but 18 millions came from Germany and 20 millions from other European countries.

This country, as a whole, does not look with favour upon enterprises that demand financial aid from the State, and the experience of continental countries that at least an initial period of nursing is needed to develop a successful beet-sugar industry has aroused opposition to the adoption of such a scheme in Great Britain. On the other hand, most of those who are convinced by the argument of national security would admit that such an industry should receive support only for a limited number of years, after which it would have to be self-supporting or go under. Therefore the question of the conditions of the commercial possibility of a home beet-sugar industry is one of considerable importance. These conditions are known from the experience of other countries, and may be summarised as

follows:—(1) Suitable climate and soil; (2) co-operation among agriculturalists and beet-sugar manufacturers; (3) good and cheap transport; (4) availability of good, cheap limestone and coal; (5) an adequate supply of skilled and unskilled labour; (6) unlimited supply of water to the factory; (7) a ready market for the by-products; and last but not least, (8) absence of unduly great fiscal burdens, to wit, a prohibitive excise duty and excessive capitalisation.

The Kelham Estate.

The enterprise which is the subject of this article resulted from the efforts of the British Sugar-Beet Growers' Society, Ltd., which was founded in 1915 by Mr. Alfred Wood, although due credit must be given to the valuable pioneer work done from 1911 onwards by the National Sugar-Beet Association and its president the Earl of Denbigh, who is now chairman of the Society. Thanks to a grant of money advanced by H.M. Treasury from the Development Fund, the Society mentioned was able to purchase in 1917 the Kelham Estate of 5603 acres, near Newark, Notts. About one-half of the Estate was sold in 1919 to the Ministry of Agriculture for the settlement of ex-Service men, but the remainder was developed by the Society and transferred to Home-Grown Sugar, Ltd., a company formed in 1920 with the financial assistance of the Government (*cf.* J., 1920, 223 r). Of the 2841 acres now comprising the Kelham Estate, 1866 acres is managed as one farm, and 835 acres is arable land capable of producing about 6000 tons of sugar-beet per annum as a rotation crop, the average yield anticipated being 10–12 t. per acre of roots containing about 16 per cent. of sugar. Up to date sugar-beet has been cultivated on about 230 acres, and some 2300 acres have been grown locally by 425 farmers (an average of 5.5 acres each), who for last season were guaranteed the price of £4 per ton for topped beets delivered at the factory. The sugar-content of the roots treated during the first campaign, ended February 8, 1922, reached the satisfactory average of 15.92 per cent.

The Factory.

Home-Grown Sugar, Ltd. has been particularly fortunate in having had the assistance of the best French advice and skill in the planning, erecting and fitting of the factory, and in conducting the manufacture during the first campaign. The factory, with outbuildings, covers 32.5 acres, and was designed to treat up to 60,000 t. of beet, or 600 t. per day of 24 hours for a normal campaign of 100 days. From this quantity the expected yields were 8000 t. of sugar, 3000 t. of dried beet-pulp, and 1800 t. of molasses. The consumption of coal (from the Midland coalfield) was estimated at 6000 t., of limestone (from Derbyshire) 3000 t., and of water 2.5 million gallons per day (Trent water) for washing the roots and 300,000 galls. (town-supply) for the diffusion process. Transport facilities are excellent; there are three miles of sidings connecting with the Midland and Great Northern Railways, the navigable Trent with its tributary waterways, and two good main roads. The factory staff is almost entirely French, M. Henri Thiery being manager and M. Hot chief chemist, and the necessary untrained labour was recruited locally. Twenty-five thousand tons of sugar-beet was treated during the campaign, and no difficulty was found in marketing the 2000 t. of sugar produced or the 1500 t. of dried pulp molasses.

The factory was designed on the most modern lines by the Cie. de Fives-Lille, of Lille and Givors, France, which also supplied most of the plant, but the boilers and centrifugals are of English make and the drying machinery in the pulp-drying room

is German. The main building includes the machinery hall, which covers an area of over 13,000 sq. ft., the cossette-presses annexe of 3 floors, a "mixers" annexe, the filter-press department of 2 floors, pulp-drying room, sugar-store, and boiler-house; and the out-buildings comprise the dried-pulp store, lime-kiln, machine-shop and store, customs office, 3 weighbridge offices, coke- and locomotive-sheds, and the general offices.

The Financial Problem.

Practically the only difficulty is the very important one of finance. The factory was erected during a period of very inflated prices; the company suffers from heavy capitalisation; and the price of sugar has fallen by about 50 per cent. during the past year. From the technical standpoint the campaign was quite successful, particularly in view of the inevitable difficulties incidental to "tuning-up," but there has resulted a large deficit on the working, a deficit which is largely accounted for by the big sum of £40,000 paid by the company for excise duty. The position, therefore, appeared very unfavourable, and the directors made urgent representations to the Government to remit the duty until such a time when the home industry could produce a total of 50,000 t. of sugar per annum. After an initial refusal, the Government has complied with the request (*cf. p. 161 n* of this issue), so that the company and all those who wish to see the industry established in this country on a firm and lasting foundation can now regard the immediate future without serious misgiving. Below will be found a brief description of the process of manufacture, which is identical with that practised in the up-to-date factories of Northern France.

Process of Manufacture.

The cycle of operations outlined below will be better followed by referring to the diagram on the opposite page.

On arrival the beets are stored in silos, of which there are six, built of ferro-concrete (each 100×7 metres) and with a total capacity of 6000 tons. At the bottom of each is a narrow water-channel or "flume" by which the beets are conveyed to the factory near by. Inside the factory the beets are raised in perforated steel buckets suspended from the inner rim of a wheel 8 m. in diameter to the beet-washer, in which they are stirred by revolving steel paddles, and thence passed over stone- and weed-separators. Thus cleaned, the roots are raised by a bucket-elevator to the top of the building, where they are weighed on an automatic machine, and then allowed to fall into the "cutters." These (2) are of the Maguin type, the drum rotating on a horizontal axis and the knives being attached to the periphery. Each "cutter" (diam. 1·5 m.) rotates at the rate of 70 r.p.m. and the cut slices (cossettes) are passed down a chute into the "diffusers."

The diffusion battery consists of 11 vessels (each of 55 hectolitres capacity), arranged in series in two lines, between every two of which there is a "heater" to maintain the temperature of the contents at about 70° C. The juice, containing about 12·5 per cent. of sucrose, is drawn off from the bottom of the last vessels, screened from fine pulp and measured. The spent cossettes are pressed to remove liquor and then conveyed to the pulp-drying room where they are mixed with molasses and dried mainly by waste heat; the resulting product, which has been readily sold as a stock-feed at £7 10s. per ton, contains approximately 22·5% sugar, 8·5% proteins, 51·5% fibre, fat, etc., 5·7% ash, and moisture, 11·8%.

The thin juice from the diffusers is heated to 70–80° C., treated in large tanks with milk of lime,

and then pumped into two of the four carbonation tanks (each of 100 hl. capacity), where gassing with carbon dioxide is carried out at about 75° C., and the alkalinity reduced to 0·9–1·1 g. per litre. After filtering, the liquid is reheated, treated with more lime, passed into the second carbonation tanks, gassed with carbon dioxide until the alkalinity is 0·10–0·15, and then filtered. The lime-sludge from the second filtration is conveyed into the first set of filter-presses, the sludge in which is washed with warm water, the first washings being added to the filtrate and the last used to make milk of lime. The spent lime-sludge is pumped to the factory yard where it is stored to be sold as a fertiliser.

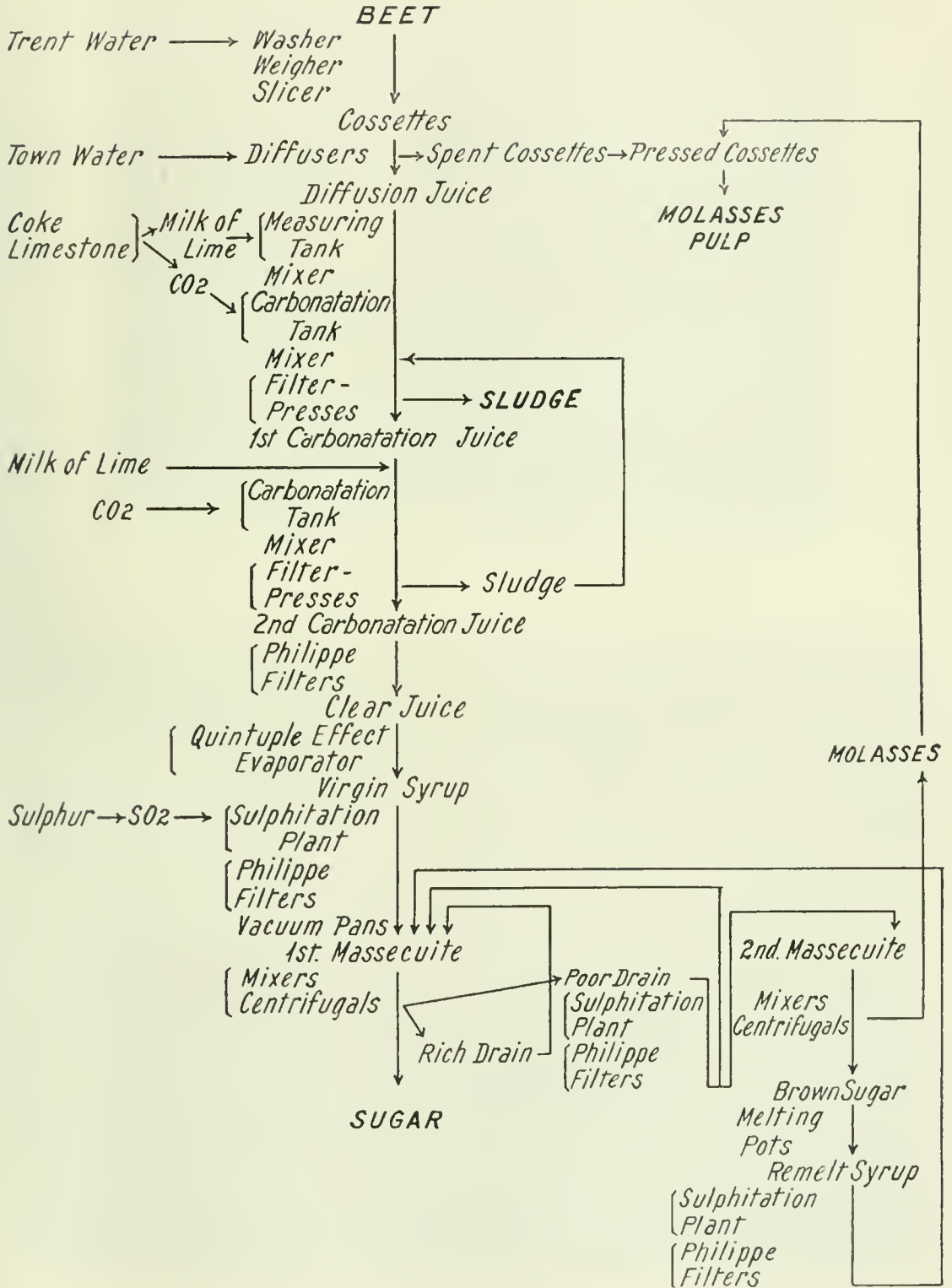
The next stage consists in converting the clear juice into virgin syrup by evaporation in a quintuple-effect evaporator, which is supplied with exhaust steam from the power-house and some live steam at 160 lb. The condensed steam from the fifth unit, and also from the vacuum pans (*cf. i.*), is returned to the boilers.

The virgin syrup, containing about 50 per cent. sugar, is sulphited (Quarez continuous system), filtered in Philippe filters, and the clear liquid passed into the vacuum pans, where it is boiled to grain together with other liquors obtained in subsequent stages of the process (*cf. i.*). The vacuum pans are of 250 hl. capacity, and the two first are heated by steam from the second unit of the quintuple-effect evaporator. From the vacuum pans the mixture of syrup and crystals, or "massecuite," is discharged into large tanks called "mixers" (*malaxeurs*), where it is cooled and kept in constant motion by a large screw. It is then conveyed to the tank feeding the battery of six centrifugals (Watson Laidlaw), in which the sugar is separated from the "poor drain," which is sulphited and filtered. The crystals are then washed, giving the "rich drain," which goes back to the first vacuum pans. The purified "poor drain," according to its purity, is either returned to the first vacuum pans, or evaporated separately in the second vacuum pan to give the second massecuite. This in its turn is cooled in mixers and centrifuged, yielding brown sugar (*sucré roux*) and molasses. The brown sugar is re-dissolved (re-melt syrup), sulphited, filtered, and returned to the first vacuum pans. No refining is done, and the white granulated sugar produced has found a ready sale at 4d. per lb. below the price of the best refined sugar. The following are typical analyses of the sugar and molasses produced:—

Granulated White Sugar.		Molasses.	
	Per cent.		
Polarisation ..	99·00	Brix ..	(77·7) (total solids).
Water ..	0·05	Sugar, % ..	46·6
Ash ..	0·01	Water, % ..	(22·3)
Reducing sugar ..	0·00	Ash, % ..	10·00
Organic matter ..	0·04	Salt coefft. ..	4·66
(by difference)	100·00	Purity, % ..	(60·00)
Rendement (coefft. 5) ..			
(polarisation—5×ash)....		90·85	

The power-plant consists of four Stirling boilers working at 170 lb. per sq. in. pressure, and driving four steam-engines, the firing (underfed stokers and travelling grate) requiring only two men per shift. The four engines are Corliss expansion engines ranging from 180 to 300 h.p.. There are two dynamos, 220 kv.a. for power and 30 kv.a. for lighting, and eleven three-phase electric motors. In the engineering shop is a Ruston-Hornsby heavy oil-engine of 30 h.p.

In conclusion, the writer wishes to acknowledge his indebtedness to Mr. Alfred Wood, secretary of Home-Grown Sugar, Ltd., for permission to view the factory and for much information received, and to M. Hot and Mr. J. G. Maltby for information of a more technical character.





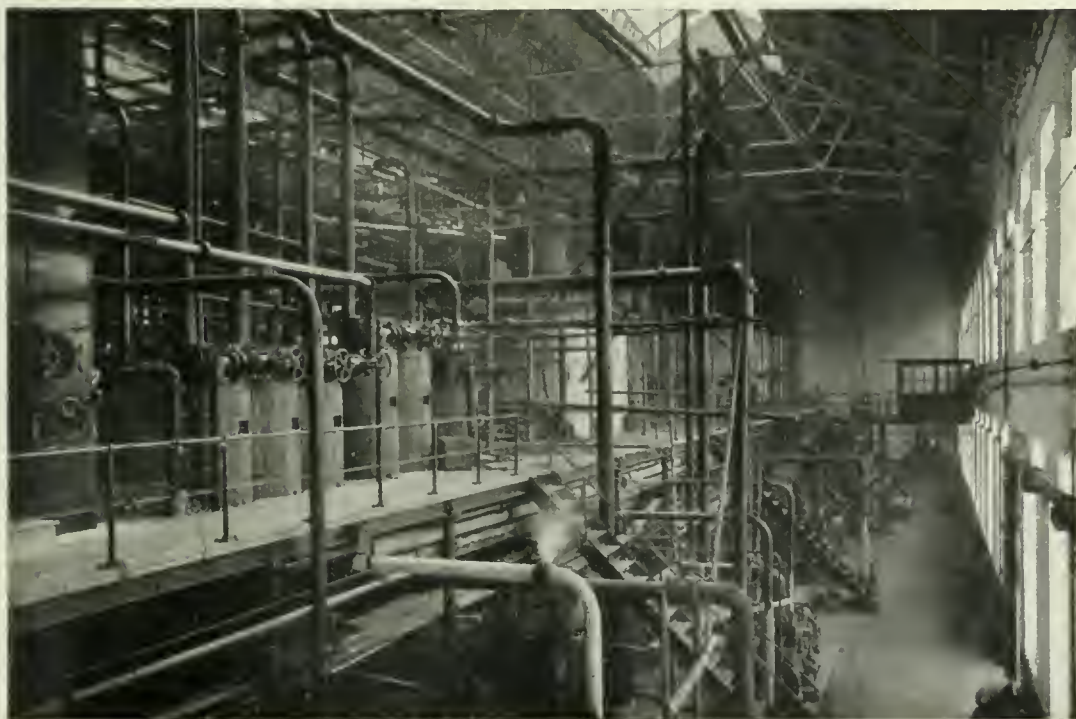
The Beet Silos, showing Rail and Road.



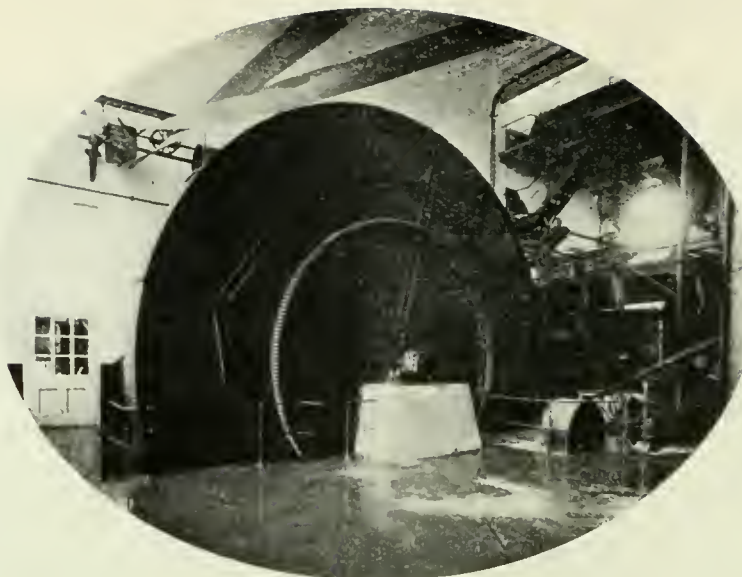
The Factory from the Great North Road.



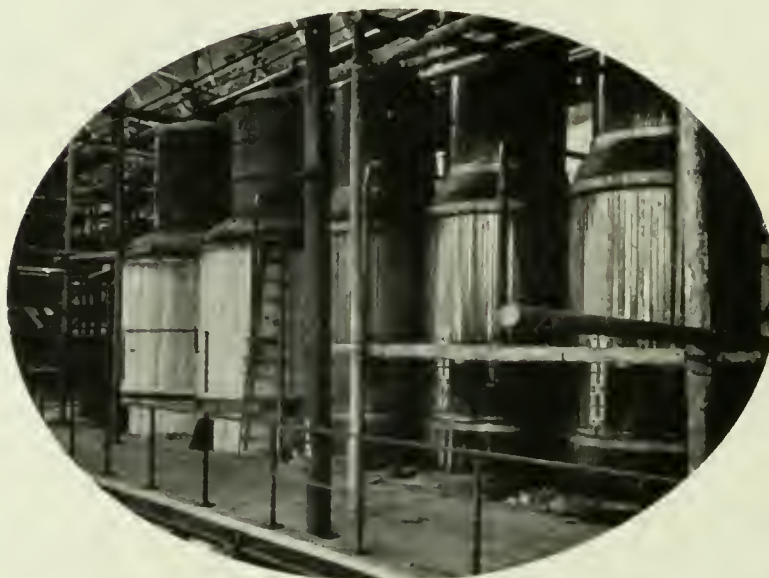
Machinery Hall from the Mixers and Centrifugals, looking North.



Machinery Hall from the Diffusion Batteries, looking South.



The Beet Wheel and Washers.



Quintuple-Effect Evaporators.



Pulp-Drying Room, showing Kiln, Drying Drum and Presses.

MEETINGS OF OTHER SOCIETIES.

ROYAL SOCIETY OF ARTS.

A paper on "The Indigo Situation in India" was read by Prof. H. E. Armstrong at the meeting of the Indian Section held on March 24, Sir Thomas Holland presiding.

Prof. Armstrong, referring to the impending abandonment of research work on indigo in India (cf. J., 1922, 79 R), said that the decision was not due merely to impecuniosity but to inability to appreciate the issues at stake. To compete with the synthetic indigo (indigotin) natural indigo must be prepared as a paste of standard strength, containing as nearly as possible 20 per cent. of indigotin, and to achieve this the planters must bulk their products. Indigotin had captured the trade owing to its standard strength, uniform colour and fineness of division, and because it could be used without mechanical preparation. A fair share of the trade should be secured for natural indigo, not only because it was a better dyestuff, but because the time might come when the raw material for manufacturing indigotin would be lacking. The chief disadvantage of natural indigo—the long and troublesome preparation required to fit it for the dye vat—had been overcome, and a paste was now made from dry indigo, which was superior to indigotin for most dyeing processes. This superiority was probably due to the specific effect of indigo brown in the dye vat. Difficulties due to bacterial action in the paste had been overcome by adding to the paste 0.05 per cent. of paranitraniline, which retarded bacterial action and did not interfere with the dyeing process in the English climate. The last work of the Indigo Research Chemist, Mr. W. A. Davis, has been to devise a method for air-drying indigo and obtaining it in an easily pulverulent form, so that grinding was practically unnecessary.

The chief problems in the extraction and manufacture of indigo from the Java plant were shown to be (1) the nature of the process by which the impermeable leaf was rendered permeable to water, so that indican could pass out into solution, and (2) the process by which hydrolysis was effected. Permeability probably resulted from the death of the leaf and the consequent degradation of the vital mechanism. Carbonic acid certainly played a very important part in the whole process, and organisms had been shown to play a preponderant part in splitting indican. Mr. Davis had concluded that indican was hydrolysed to indoxyl practically as fast as it was extracted from the leaf. Indoxyl existed in solution in two interconvertible forms, one of which gave rise to indigo brown, whose nature was unknown. Much of the so-called indigo-gluten present as impurity in indigo was formed by the solvent action of carbonic acid on the proteinaceous substances of the leaf.

Production of indican being a symptom of starvation, the main factor affecting it was a low nitrogen-content in the soil, but to secure a maximum yield the starvation must be limited to nitrogen; organic matter (to furnish carbohydrates) and soluble phosphates should be present in good supply.

Discussing the nodular growths on the roots of leguminous plants and the nitrogen-fixing organisms contained in them, Prof. Armstrong said that when the nitrogen supply was abundant the plant functioned normally, but when nitrogen was lacking the nodular bacteria were forced into activity. These organisms supplied nutriment apparently of a special kind. Probably the nitrogen was laid down initially as a protein, the elements of which were duly translocated into the plant. To account for the increase in the content of indican under the influence of nodular growths, it was only necessary to suppose that one of these elements was present in

relative abundance and yielded indoxyl on reduction.

The lesson to be drawn from this work on indigo was the necessity for more study of leguminous crops. Agriculture was the chief industry of India, and the cultivation of indigo was undoubtedly its most important branch.

Sir Thomas Holland said that the decision to discontinue research on indigo would not affect the Indian taxpayer as the research was paid for by a cess, imposed in 1918, of one rupee per bazaar maund of indigo exported. The money therefore was drawn not from public revenues but from the trade itself. Even if the sums collected had not covered the whole cost of research, the money would certainly be recovered when the export trade revived; stoppage of the work just when results of commercial value were beginning to be obtained would be wasteful. The researches of Mr. Davis had led to results immensely important to agriculture, and indigo had shown itself to be so valuable as a nitrogen-fixer that some planters considered it necessary to grow the plant solely for manure. To allow natural indigo to be replaced by indigotin, or to allow cultivation of the crop to be confined to other countries, would place the Indian textile industry at the mercy of the foreigner. The danger was not only inevitable but immediate, as indigotin was neither made, nor was likely to be made in India. It was not true that the research work was discontinued because it would mainly benefit European planters and traders; in fact, the area planted by small Indian cultivators and the amount of indigo produced by them were far in excess of the area of the crop or the production on European-owned plantations. The export trade was mainly in the hands of European traders who were thus the only people that contributed to the cost of research. It had been suggested that the planters and European traders might finance the work, but they already paid the export cess, and before asking them to do anything more, the arson and violence in the very districts where indigo planting was carried on under European management had to be remembered. In concluding, Sir T. Holland said that if the issue were put fully before the Legislative Assembly, he was sure that the vote for continuing the research would not be denied.

INSTITUTION OF CIVIL ENGINEERS.

At the meeting held on April 4, Sir R. A. Hadfield read a paper on the "Corrosion of Ferrous Metals," in which he described the preparation and properties of the ferrous metals used in the research on corrosion conducted by a committee of the Institution which was formed in 1916 to investigate the deterioration of structures exposed to sea-water. The investigation related to 14 types of ferrous metals, divided into four main sections, viz., (1) rolled and forged irons, (2) carbon steels, (3) special steels, and (4) cast irons. These types were represented by 1330 separate specimens (each 24×3×0.5 in.), of which 955 had already been allocated. Experiments were carried out on 192 test-pieces as follows:—(1) Complete analysis; (2) tensile tests on bars cut longitudinally; (3) Frémont shock tests in both longitudinal and transverse directions; (4) Izod shock tests in the longitudinal direction; (5) Brinell hardness numbers; (6) photomicrographic tests in both longitudinal and transverse directions; (7) detailed elongation tests. After describing the properties of the material used in the investigation, data for non-rusting steel were given showing that the resistance of this steel to corrosion when almost constantly wetted by sea-spray depended on its physical constitution.

Sir R. Hadfield then discussed the theories of corrosive action and the behaviour of special materials and pointed out that the beneficial effect of copper on the resistance of steel to corrosion was not fully established; for preventing or mitigating corrosion the addition of copper to steel was not generally advisable. Attention was called to the wastage due to corrosion. Thus the world's output of iron and steel during the period 1860-1920 was estimated at 1860 million tons, of which 660 million t. was probably lost by rusting in use. The loss due to corrosion in 1920 was estimated at 29 mill. t., so that with steel at £20 per ton and making allowances for protection, the wastage represented an annual cost of over £700,000,000. The hope was expressed that greater interest would be taken in the production of alloy steels that resist corrosion.

PAPERMAKERS' ASSOCIATION OF GREAT BRITAIN AND IRELAND.

The annual meeting and fifth general conference of the Technical Section of this Association was held in London on March 23. The retiring chairman, Mr. Arthur Baker, of the Empire Paper Mills, Ltd., was succeeded by Capt. W. E. Nuttall, of Messrs. Cooke and Nuttall, who selected as the subject of his address "The Future of the Section." In the afternoon Mr. James Strachan read a paper on "The Piezo-Micrometer and Its Application to Paper Testing," and Mr. C. F. Cross gave an address on "Research in Industry."

The membership of the Section is now 290, and the parent body has approved of proposals by which a modest scheme of research will be undertaken into fundamental problems of the industry.

SOCIETY OF PUBLIC ANALYSTS.

Five papers were read at the meeting held in the Chemical Society's Rooms on April 5, Mr. P. A. Ellis Richards presiding.

(1). The paper by Messrs. O. D. Roberts and H. T. Iskip on "The Constants of Indian Beeswax" referred to samples of beeswax collected in Bengal and Assam, and showed that the constants of many of them were appreciably different from those previously recorded for genuine samples of Indian beeswax.

(2) and (3). After quoting analytical data for the liver oil of the Tope (*Galeus galeus*), a fish belonging to the shark family, Mr. A. Chaston Chapman read a note on the examination of foods for the presence of sulphites. The method generally adopted for determining the presence of sulphurous acid or sulphites may give heavy indications of these substances even when no sulphite has been added. If food products have been flavoured with, or contain, substances such as onions or mustard yielding organic compounds of sulphur on distillation, the sulphur may be partly or wholly oxidised to sulphuric acid by the bromine water; consequently the analyst may infer, wrongly, the presence of added sulphites. This difficulty can be avoided by substituting hydrogen peroxide for bromine or iodine in the distillation process.

(4). In a paper on "Certain Tropical Oilseeds" Messrs. E. R. Bolton and D. G. Hewer described the nuts or seeds of *Platonia insignis*, *Andirobinha*, *Baillonella* sp., *Parinari* sp. (seeds), *Theobroma grandifolia*, and *Theobroma bicolor*, gave analytical data for the oil and fats obtained, and suggested uses.

(5). Mr. A. Bruce read a paper on "A Tropical Milk Supply," and Mr. S. H. Groom demonstrated the use of the Sheringham system of artificial daylight in the laboratory, and suggested that it made possible the use of indicators that cannot be employed with ordinary artificial light.

NEWS AND NOTES.

FRANCE.

Industrial Notes.—Metallurgy.—The slight improvement in the metallurgical market is apparently partly due to the greater confidence inspired by the resuscitation of the "Comptoir Sidérurgique"; but although prices of a few products have been lowered, orders are still scanty. The remedy suggested by the metallurgists is the imposition of prohibitive import tariffs, but the consumers of metallurgical products oppose this as they must buy raw and semi-finished products at the lowest possible prices, otherwise they will be unable to meet foreign competition. It thus remains for the metallurgical industry to see what it can do to reduce prices.

General.—The commission appointed to consider the revision of the customs tariff has decided, by a majority of one, to raise the "co-efficient of increase" applied to dyes from 3 to 6. The old tariff rate, however, is still applied to dyes not made in France.

It is stated to be practically certain that when the administration of the Alsatian potash mines is discussed in Parliament next month, the Government will support the following scheme:—(1) The mines to be entrusted to a single company; (2) farmers to be entitled to take up 50 per cent. of the shares in the company; (3) the board of directors to include three representatives of the State, viz., one each for agriculture, mines and the Treasury; (4) creation of a central sales-organisation for the sale of potash both at home and abroad.

The production of refractory crucibles and electro-technical porcelain is becoming increasingly important. Owing to the establishment of hydro-electric works, the market for electrotechnical porcelain is growing steadily, and French refractory crucibles command a ready sale both at home and in the foreign market.

The agricultural school in the Pas-de-Calais Department, which was formerly situated at Berthouval, near Arras, but was destroyed during the war, is now being built at Tilloy-les-Mofflaines, also near Arras. The new school will accommodate 90 pupils from 14 to 18 years of age, and eventually a winter school for 40 adult students will be added.

Colonies.—The Government is preparing a scheme for developing the French Colonies which will involve the issue of a big loan on the combined security of the State and of the immense resources of the colonies themselves. The labour problem is very difficult in certain colonies, such as West Africa, where much of the labour is usually recruited for defence purposes, leaving but little for agriculture and industry. It is suggested that, when trained, recruits should be detached for civilian work in places not far from their units.

AUSTRALIA.

Sugar-beet Cultivation in South Australia.—The report of the South Australian Director of Agriculture announces the success of the experimental cultivation of sugar-beet at Millicent and Penola; the mean yield during the past three years has been 9.79 tons per acre, and the maximum yield 16.68 t., at Millicent in 1918-19. The mean yield was higher than that obtained at Maffra between 1910 and 1917 (*cf.* J., 1921, 311 R) and the average sugar-content, 16.7 per cent., was satisfactory. Sugar-beet could, it is stated, be grown successfully in the south-east if at least 2250 acres (the area necessary to keep a factory supplied) were planted and a modern factory built, but the River Murray area would probably be better, owing to the availability of water for irrigation.—(*Ind. Austral.*, Jan. 26, 1922.)

Queensland Timbers for Paper-Making.—The West Australian Forest Products Laboratory which discovered some time ago that the hoop pine and the silky oak are suitable for making brown paper, now announces that the common cypress pine is superior to these, and that it yields a paper which is lighter, thicker and stronger than imported Kraft paper. It has also found that the silky elm or brown oak of the coastal forest is almost equal in value to the cypress pine.—(*Ind. Austral.*, Feb. 23, 1922.)

A New Tanning Bark in Western Australia.—As a result of investigating over 170 samples of barks, the Forest Products Laboratory of Western Australia has found that Karri bark (from *Eucalyptus diversicolor*), which contains about 20 per cent. of tannin, tans quickly and gives a light-coloured leather. At least 10 tons of this bark is stripped every day at the saw-mills and in the forests, but it has never been utilised, except as fuel. Now, however, as the result of the activities of the Forest Products Laboratory, a factory has been erected to manufacture Karri tanning extract.—(*Ind. Austral.*, Feb. 23, 1922.)

SOUTH AFRICA.

The Gold Refinery on the Witwatersrand.—The gold refinery at Germiston, which is now completed and working, is described by the *South African Mining and Engineering Journal* (Dec. 3, 1921) as the most important in the world. The buildings cover over 5 acres and comprise the following units: Refinery office, assay office, rough gold-melting house, silver-reduction and gold-refining branch, power-house and workshops, chlorine-generator house, store-rooms, coke-bins, coal-bunkers, switch- and transformer-house, garage and police-guard rooms. The operations are briefly outlined as follows:—

The bullion is weighed, melted in a plumbago crucible with suitable fluxes, and cast into ingots, which are weighed and sampled for assay; if found to contain base metals it is submitted to a preliminary refining (toughening). Bullion showing a satisfactory assay is sent to the refinery to be melted in 4-pint clay crucibles in lots of about 700 oz. each, borax being used as flux. After melting, chlorine and air are passed into the molten mass to convert the silver and base metals into chloride, and this treatment is continued until the colour of the issuing fumes shows that no more chlorides are being formed. During this process some of the base-metal chlorides volatilise, much of the remainder rises to the surface with the silver chloride and is "bailed" off and poured into a mould, and any remaining chlorides are removed by absorption with bone-ash. The fine gold is stirred, re-melted in tilting furnaces, sampled, cast into 400 oz.-ingots, and, after assay, forwarded to the refinery office for export. The gold removed with the "bailings" is recovered by melting in lots of 300 oz. with sodium bicarbonate and borax in plumbago crucibles, in which operation some of the silver chloride is reduced and the silver, containing some gold, separates, on cooling, at the bottom as a metallic button. The liquid chlorides are poured off and cast into cakes, and the metallic button is refined with chlorine, which is made from manganese dioxide, common salt and sulphuric acid in an Edward's generator. Silver is recovered from the crushed chloride cakes by removing the base-metal chloride with hot saturated brine, and then reducing to silver sponge with iron and dilute sulphuric acid in a steam-heated vat. The reduced silver is washed with hot dilute sulphuric acid and water, dried, melted, and cast into ingots of 1000 oz., and if necessary impurities are removed by stirring potassium nitrate into the molten metal.

All pots, ashes, clay pipes, etc., used in the refinery are ground in ball-mills to pass a 60- or

80-mesh sieve, and the metals recovered are treated with chlorine. The tailings are treated in lead and cupellation furnaces to extract any precious metals that remain. Scrap iron is used to precipitate the silver and copper in the solutions obtained by reducing the silver chloride and the residue is sent to a smelter. Throughout the refining all assays are made in duplicate on different samples by different assayers using different methods and apparatus.

BRITISH INDIA.

The Indian Institute of Science, Bangalore.—An article in *The Times Educational Supplement* of April 8 reviews the report of the committee appointed, with Sir W. Pope as chairman, to inquire into the constitution and working of the Indian Institute of Science at Bangalore. The committee finds that the Institute is not achieving success in training Indians to become scientific leaders of industry. Although many past students have creditably filled important scientific and industrial positions, the efficiency of the Institute has been affected by the lack of a definite policy of development. Its reputation has also suffered owing to the conditions and circumstances under which some members of the staff have done private work.

It is suggested that courses of instruction should be established throughout the Institute to link up the work of students with the research work they may ultimately pursue; and it is emphasised that the work of the Institute should by no means be confined to the application of science to industry. The department of pure and applied chemistry should be retained and reinforced by establishing professorships, and chairs of general physics, applied mechanics, and electrical technology should be instituted. As the complete scheme involves a capital outlay of over £166,000, further financial support will be required, and to obtain this all Indian provinces and states should be asked to give financial or other assistance to the Institute, which, when reorganised on an extended basis, will prove of the utmost value to India.

UNITED STATES.

Chemical-Warfare Service.—The War Department Appropriation Bill, recently presented to the House of Representatives, provides for the expenditure of only \$517,240 on the Army chemical-warfare service for the fiscal year 1923. General Amos A. Fries, chief of the service, giving evidence before the appropriations committee, asked for \$10,000 for manufacturing hexachlorethane, \$30,000 for general research, and \$33,000 for mechanical laboratory work. He observed that it was impossible to limit the use of asphyxiating gas in future wars, and that the methods of chemical warfare could be applied in peace time to control pests and to develop means of protecting firemen, miners and others against poisonous gases.—(*Oil, Paint and Drug Rep.*, Mar. 20, 1922.)

A Chemically Controlled Automobile.—Realising that the development of the automobile has been almost entirely mechanical, and that study of the composition of gasoline in the engine as a rather complicated chemical reaction has been overlooked, G. G. Brown, of the Chemical Engineering Department of the University of Michigan, has attacked the problem of impending motor-fuel shortage from the standpoint of more efficient combustion, and he has described his work in the *Journal of Industrial and Engineering Chemistry*.

After studying the thermodynamic problems of the gas engine, and the combustion factors and decomposition products of gasoline, Mr. Brown developed a new type of carburettor designed on an

exact mathematical basis to deliver a definite mixture of gasoline and air for each condition of temperature and load. As this carburetter is automatic and positive in action, much better chemical control can be obtained by its use than with a dashboard adjustment even in the hands of a skilled operator.

By application of the principles of chemical control developed, a standard Ford touring car, which when driven under ordinary conditions averaged 19 miles per gallon, maintained a monthly average of 30 miles. Automatic chemical control of a Pope-Hartford car weighing 39 cwt. increased the mileage from 8 to 18 miles per gallon.

The Alaskan Mining Industry in 1920.—Bulletin 722-A of the United States Geological Survey states that the mining industry in Alaska, as a whole, was seriously depressed in 1920, and that the increase of nearly \$4,000,000 in the value of the output, compared with that in 1919, was due to the great increase in the production of copper. During 41 years of mining, Alaska has produced minerals to the value of more than \$461,000,000, over half of which represents the output of the last decade. Of this sum \$320,000,000 is the value of the gold and \$127,000,000 that of the copper.

Sand-Lime Brick in 1920.—According to the United States Geological Survey, the quantity of sand-lime bricks produced in 1920 was 169,761 thousands, valued at \$2,490,238, representing an increase of 16 per cent. in quantity and 46 per cent. in value compared with 1919, but 10 per cent. less and 101 per cent. greater, respectively, than in 1913. About 99 per cent. of the output was sold as common brick at an average price of \$14.61 per thousand, and the average price for face brick was \$19.48 per thousand. Michigan, Minnesota, Wisconsin, Florida and New York are the chief producing States.

Tropical Plants as Possible Sources of Alcohol.—Prof. H. N. Whitford, of the Yale School of Forestry, has been investigating the "Possibilities of Plant Growth of the Moist Tropics to Furnish Materials for Liquid Fuel." He finds that one acre of ground in the tropics can be made to yield five times as much timber in a given time as the same area in the temperate regions. Of plants other than trees, two which seem promising for the production of alcohol are certain species of bamboo and the Nipa palm. Cassava leads among the agricultural crops in the author's estimation, but maize, rice, cotton, and sugar-cane are mentioned as favourable, especially as, with the proper cultivation, two crops per year could be grown.

Fuller's Earth in 1920.—The fuller's earth industry in the United States continued to develop during 1920; valuable deposits were discovered in the States on the Pacific Coast and promising deposits in several other States. The output—the largest recorded—was 128,487 short tons, valued at \$2,506,189, or an increase of 21 per cent. in quantity and 25 per cent. in value compared with 1919. Compared with 1913 the output increased in quantity and value by 3 and 7 times, respectively. Florida produced about 85 per cent. of the total. Imports increased by 39 per cent. to 19,235 t. (\$221,893), of which 81 per cent. was manufactured. The average price of the domestic product was \$19.51 per short ton, as against \$11.54 for imported material (*cf. J.*, 1921, 328 R).—(*U.S. Geol. Surv.*, Aug. 28, 1921.)

Water Power of the World.—Under this title the United States Geological Survey has issued Part II of its "World Atlas of Commercial Geology" (37 pp., 10 maps, price \$1).

The potential water power of the world is estimated at 439 million h.-p. at low water, of which

62 million h.-p. is in North America and 28 million in the United States. Africa is richest in undeveloped water power, with 190 million h.-p.; Asia has 71 million, South America 54 million, and Europe 45 million h.-p.

About 40 per cent. of the developed water power of the world is in the United States, where water wheels having a capacity of 9,243,000 h.-p. are installed. The leading States are New York, with 1,300,000, and California, with 1,111,000 h.-p. In Europe France leads with 1,400,000 h.-p., Norway has 1,350,000, Sweden 1,200,000, and Switzerland 1,070,000 h.-p.

The largest water-power development in the world is at Niagara Falls, where the plants now in operation have a capacity of 870,000 h.-p., of which 385,000 h.-p. is on the United States side. The capacity on both sides is now being increased.

GENERAL.

Mineral Resources of Yugoslavia.—The report issued by the Department of Overseas Trade (Pp. 104, price 3s. 6d.) on the geology and mineral resources of the Serb-Croat-Slovene State and of Montenegro, contains a detailed account of the mineral wealth of these countries together with information on the condition of their mining industries. It is stated that the minerals in Slovenia, Croatia and Slavonia have been exploited to a greater extent than those in Bosnia, Herzegovina and Serbia, where development has been handicapped by inadequate transport. The chief minerals are coal, iron ore, and copper.

Practically all the coal mined is either brown coal or lignite, and the reserves are estimated at 1900 million metric tons, distributed as follows:—Bosnia and Herzegovina 90%; Slovenia 6%; Serbia 3%; Croatia, Slavonia and Dalmatia 1%. The deposits of iron ore are not large, and the chief mines are at Vares and Ljubia, in Bosnia, where the reserves, mainly siderites, limonites and hæmatites, are estimated at 30—40 million t.; deposits in the other States are comparatively unimportant. Prior to the war the output of the State-owned Vares mine was 200,000 t. per annum, most of which was smelted at Krapuli. The Ljubia deposit is probably the most important in Yugoslavia.

Iron pyrites is mined in various localities, especially at Bakovitsi, where the annual production was 5000 t.; this mineral is also obtained in lead and copper mines, etc. Sulphur was formerly worked extensively at Rada Boj, near Krapina, in Croatia. The chief copper mines are in north-eastern Serbia at Majdanpek and Bor, where the pre-war output was roughly 7000 t. per annum. Lead mines are numerous and the annual output of ore at Misitsa in Slovenia is about 6000 t. Zinc ore is won in several localities, but in small quantities; and it is smelted mainly at Celje, the production in 1915 being 4025 t. of metal. The only important manganese mine is at Cevljanovitsi, near Sarajevo (Bosnia); 12,000 t. of graded ore containing 46 to 55 per cent. manganese is produced annually from this mine. Antimony is obtained principally from the Podrinje department of Serbia; chromium ore (chromite) from Dubostitsa in central Bosnia and Aliehar (near Monastir) in Serbian Macedonia; molybdenum (wulfenite) from Misitsa in northern Slovenia; arsenic (orpiment and realgar) from Aliehar; mercury (cinabar) from Idria in western Slovenia; bauxite from Boh Bistritsa in Slovenia and from Rudo Polje in western Croatia; salt from the coastal regions and from Tuzla (Bosnia). Other minerals whose occurrence is recorded but which are not worked include nickel pyrites, bismuthine, kaolin, magnesite, asbestos, barytes, gypsum, and fluorspar.

Gold mining has been carried on from ancient times, especially in Old Serbia and central Bosnia,

and silver has been recovered occasionally from silver-lead ores, but the production of these metals has never been important. The formation in several localities appears to indicate the possible presence of petroleum, but it has been proved in quantity only at Bujavitsa and Selenitsa in Croatia, where natural gas and heavy tarry oil were obtained. Asphaltic limestones have long been worked along the coast from Zara to Ragusa, the bitumen content ranging from 20 to 83 per cent.; the mines at Selenitsa yielded over 7000 t. of bitumen per annum before the war. Paraffin shales occur in the Kolubara valley in Serbia and at Alexinats, north of Nish.

The appendices to the report contain a bibliography of the Yugoslavian mining industry, a glossary of the chief Serbian mining terms, the Serbian mining laws, an index of localities, and several topographical and geological maps.

The Tartar Industry in Italy.—In the issue of *Il Sole* for February 12, Prof. E. Molinari discusses an article on the Italian tartar industry contributed by the Hon. A. Marescalchi to a previous issue. According to Signor Marescalchi, the industry has developed satisfactorily in recent times, four large, modern factories (at Barletta, Milan, Casale and Agnano) and several smaller ones having been established. Since the war, however, England and Germany have again been buying the raw material on a large scale and re-exporting the refined products to Italy, with the result that the home industry cannot compete and is being forced to cease production. To remedy this it is suggested that the export duty on tartar materials should be raised from 5 lire (paper) per quintal to 20 gold lire for material containing up to 50 per cent. of bitartrate, and up to 32 gold lire for richer grades.

Prof. Molinari points out that some years before the war the industry was able to compete successfully in the world's markets and thinks that although its present bad position might have been avoided by diplomatic action, the real cause has been the closure of the English market since October 1 last. The application of a temporary but heavy export duty by way of reprisal would have forced England to see reason, especially as the international market for refined tartar products is centred in London. The course of the Italian industry during the last 15 years is shown by the gradual decrease in the export of the raw materials and increase in the export of refined products:—

	Exports			Imports.	
	1913.	Metric tons.	1920.*	1921.*	
Crude tartar	8505	..	8075	..	2000
Wine "fecula"	4054	..	161	..	400
Tartaric acid, refined ..	2846	..	2918	..	1300
Cream of tartar, refined ..	318	..	539	..	500
Tartaric acid	40.3	..	51.2	..	40
Cream of tartar	33.7	..	15.1	..	50

* Figures for 1921 are estimates.

From an average annual output of 7 million metric tons of grapes, together with part of the "vinaccia" and other residues from wine-making (roughly one-half is said to be wasted), at least 20,000 t. of crude tartaric material could be produced, corresponding to 12,500 t. of refined products. Thus the industry is capable of considerable development; it is well supplied with technical men and skilled labour, and can obtain sulphuric and hydrochloric acids and soda made in Italy as cheaply as the foreign equivalents. Apart from the closure of the English market, the chief difficulties are the high import duties on certain products required for the industry, and the extremely heavy railway rates for hydrochloric acid and sulphuric acids and soda.—(*G. Chim. Ind., ed App., Feb., 1922.*)

Petroleum Output in the Dutch East Indies.—The following table shows the production of petroleum in the Dutch East Indies during the past four years:—

	1917.	1918.	1919.	1920.
Sumatra	481,277	510,950	521,756	536,482
Java and Madura ..	227,815	241,211	258,655	352,474
Dutch Borneo	869,262	999,426	1,372,140	1,455,227
Ceram Island	2,250	3,574	7,311	21,137
Total	1,605,610	1,764,201	2,159,802	2,365,320

—(*U.S. Com. Rep., Jan. 2, 1922.*)

Exports of Vanadium Ore from Peru.—During 1920, 10,534 metric tons of vanadium ore, valued at \$1,237,281, was exported from Peru, and the whole of it went to New York. Only four shipments, aggregating 2362 t., and valued at \$277,400, were made in the first half of 1921. The chief exporting company states that the maximum vanadic-acid content of the ore shipped during the past two years has been 26 per cent., and the average 20 per cent. This company, however, has ceased operations and further important shipments were not expected during 1921.—(*U.S. Com. Rep., Jan. 2, 1922.*)

Bauxite and Chromite in Togoland.—A report on the geology of western Togoland by Mr. T. Robertson states that bauxite occurs on the Agu Mountains in Togoland but that all the other laterite deposits in the country are of the ordinary impure type. Deposits of chromite occur at Djeti Hill, near Dadja, but much of the mineral is patchy and mixed with chlorite and serpentine. German analyses of samples from five prospecting pits were as follows:—Chromic oxide 36.4–41.7%; silica 1.8–8.7%; magnesia 19.1–21%; alumina 18.9–23.7%; ferrous oxide 11.8–14.9%; nickelous oxide 0.4–0.8%; with traces of sulphur trioxide and phosphoric anhydride. The area is very restricted and the deposit is not likely to prove of great economic value.—(*Bull. Imp. Inst., XIX., No. 3, 1921.*)

Production of Coal in Spitsbergen.—A Norwegian consular report states that the coal deposits of Spitsbergen are estimated to contain at least 10,000 million tons of coal of various grades in veins ranging from 2.5 to 10 ft. and averaging 4 ft. in thickness. Production has fluctuated in recent years, but rose from 40,000 t. in 1914 to 95,700 t. in 1920, the output for 1921 being estimated at 220,000 t. The largest producer is the Stor Norske Spitsbergen Kulkompani, which bought out an American company in 1916 and possesses most up-to-date plant; extensions of the workings now contemplated or under way will bring the company's output to 500,000 t. within three years. Extensions are also being carried out by the King's Bay Kul Co., which exported 2000 t. in 1919 and 20,000 in 1920. There are four other Norwegian companies concerned in producing coal. The following analyses of three kinds of Spitsbergen coal were published by Dr. R. N. Rudmose Brown in 1919:—Carboniferous, C 75.7%, H 4.6%, O and N 9.2%, S 0.5%, ash 10.0%, cal. value 7500; Jurassic, C 76.0%, H 6.0%, O and N 9.0%, S 1.5%, ash 7.5%, cal. value 7375; Tertiary, C 81.5%, H 3.7%, O and N 11.6%, S 0.7%, ash 2.5%, and cal. value 7700.—(*U.S. Com. Rep., Jan. 9, 1922.*)

The "Social Secretary" in German Chemical Works.—The post of a "social secretary" was instituted in 1910 at the Bayer Co.'s works in Leverkusen, and the innovation worked so successfully that to-day practically every large chemical works in Germany employs one. The main duty of the "social secretary" is to gain the confidence of the workers; he hears their complaints, listens to their everyday troubles, advises them on legal matters, and generally acts as a conciliator between masters and men. He is usually given a seat on the board of

directors, and latterly he has had plenty to do in trying to make his colleagues on the board see matters from the workers' point of view.

Ammonium Sulphate as a Weed-Killer.—Charlock and other weeds in corn fields are usually destroyed by spraying with a 3 or 4 per cent. solution of copper sulphate. This substance, however, has the disadvantage of being poisonous and of checking the growth of the crop, which may thus need subsequent stimulation with a nitrogenous fertiliser. Efforts have therefore been made to discover a substitute, and as the result of experiments (described in the *Journal of the Ministry of Agriculture* for March, 1922), carried out last year in various centres, it has been found that solutions of ammonium sulphate not only kill the weeds, but stimulate the crop as well. A solution consisting of 2 cwt. of ammonium sulphate dissolved in water and made up to 60 gallons was found to destroy a wider range of weeds than copper sulphate, but was not as safe to use with pea, bean, vetch and potato crops.

PERSONALIA.

The Bessemer Medal of the Iron and Steel Institute has been awarded to Prof. Kotaro Honda.

Prof. K. H. Bauer, of Stuttgart, has succeeded the late Dr. W. Fahrion as editor of the *Chemische Umschau*.

Dr. Edgar F. Smith, president of the American Chemical Society, has been awarded the Chandler Medal of that Society.

Geh.-Rat Dr. Otto Wiedfeldt, well known as a director of Krupp's, has been appointed German ambassador to the United States, and Prof. Fehr, of the Academy for Agriculture and Brewing in Weihenstephan, Minister for Food in the German Government.

Prof. S. Berlingozzi, of the Pharmaceutical-Chemical Institute in the University of Siena, has been called to the chair of pharmaceutical chemistry in the University of Naples. Prof. G. Poma has been appointed to the professorship of industrial chemistry in the Royal School of Applied Engineering in Padua.

The University of Manchester has made the following appointments in the Faculty of Technology:—Mr. W. H. Brindley, Mr. W. Hubball, Mr. W. H. Kelly, Miss Esther Levin, and Mr. J. D. Mounfield to be demonstrators in technological chemistry; and Mr. G. Mohn to be demonstrator in metallurgy.

With great regret we record the death on March 29 of Prof. P. A. Guye, ordinary professor of chemistry in the University of Geneva since 1895, and an honorary Fellow of the Chemical Society of London.

The death, on April 4, of Dr. Andrew McWilliam is a serious loss to the science and practice of ferrous metallurgy. For many years Dr. McWilliam was assistant professor of metallurgy in the University of Sheffield, and after returning from India, where he served as Government Metallurgical Inspector, he practised as a consultant in that city.

We regret to note the deaths in the United States of Dr. Charles W. Waidner, aged 49 years, chief physicist to the Bureau of Standards, who specialised in the determination of heat and temperature measurements, and more recently in that of physical constants used in engineering; and of Dr. W. T.

Scheele, aged 62 years, who was formerly president of the New Jersey Agricultural Co., Hoboken, an authority on explosives, and an active worker in the field of chemical warfare.

From Germany is announced the death, at the age of 60 years, of Prof. René Bohn, a director of the Badische Anilin- und Soda-Fabrik and one of the pioneers of the German coal-tar dye industry. Among his many discoveries were Alizarin Maroon, Bismarck Brown, Alizarin Black, Alizarin Green, Alizarin Blue-Green, and Anthracene Blue. The death is also reported of Dr. W. P. Dunbar, professor in the University of Hamburg, and director of the State Institute of Hygiene, Hamburg, aged 59 years.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Poison Gas.

Sir R. Sanders informed Mr. Morrison that the experimental ground at Porton was not to be closed as it was the Government's duty to take all possible steps which might be necessary to protect combatants and civilians against gas attack in wartime.—(Mar. 27.)

British Farina Mills.

Answering Mr. Ormesby-Gore, Mr. Baldwin said that since the Government acquired a financial interest in these mills, 1813 tons of farina and 406 tons of "Farifeed" had been produced. All the farina had been sold (except a few tons of damaged or inferior material) at an average price of £9 10s. per ton. "Farifeed" was used in making food for animals.—(Mar. 27.)

Brazilian Trade in Dyes.

In reply to Lt.-Col. Sir J. Norton-Griffiths, Mr. Baldwin said that he would be glad to consider information and suggestions on the propaganda carried on in the Brazilian dye trade by German trading corporations with official support, and to draw the attention of British dye-makers to the importance of the Brazilian market. At present, however, German export trade was favoured by the depreciation of the mark.—(Mar. 27.)

"Reparation" Dyestuffs.

Replying to Mr. Kiley, Mr. Baldwin pointed out that the "reparation" dyestuffs held by the Government were mainly obtained at a time when any immediate or prolonged decrease in requirements in this country was not anticipated, and were intended to supplement domestic production. Any further supplies of these dyes would be restricted to those not produced in this country or for which adequate substitutes of British manufacture were not available. Slow liquidation of the original stocks was no doubt causing some difficulty to home producers, but there was no reason why the Dyestuffs Act should be withdrawn.—(Mar. 27.)

Dyestuffs (Import Regulation) Act.

Mr. Baldwin, in answer to various questions, said that up to December last confidential lists of licences granted under the Act were distributed to the members of the Licensing Committee, four of whom, representing a certain association, communicated the lists to that association. Such communication was discontinued when it was found to cause inconvenience to the Committee. The Committee granted a licence to import 3 cwt.

of Acid Alizarin, Grey G, on condition that it was used in one industry only, and refused permission to import a further 3 cwt. for use in two other industries because an entirely satisfactory substitute of British-make was not available for the first industry, but was for the other two.—(Mar. 27.)

Home-Grown Sugar.

Sir A. Boseawen gave the following answer in reply to Lieut.-Col. Courthope, who had asked if the Government had decided to grant a temporary remission of excise duty on home grown sugar:—

The Government has decided that, in view of the exceptional circumstances of this new industry, and the condition of unemployment in this country, no excise duty should be charged on home-grown sugar, and the necessary provision for the removal of the existing duty will be made in the Finance Bill of this session. It is, of course, impossible to bind any future Government, but, in view of the fact that the remission of excise is intended to assist a new industry during the experimental period, it may be hoped that Parliament would not re-impose any excise duty until the industry has been firmly established. There will be nothing imposed on the consumer. Unless this remission is made, the industry will not proceed. That is the only point. No special conditions have been laid down. As to when the remission comes into operation, the announcement which is made to-day will enable growers to plant their beet, but, of course, it cannot actually come into operation until it has been enacted by this House.—(Mar. 30.)

Answering Lieut.-Col. James, Major Barnston said that the proposed remission of excise duty would apply to all beet sugar grown and manufactured in this country. Negotiations were now in progress for the amalgamation of the Kelham and Cantley factories under British control. The Cantley factory, which was still in the experimental stage, was built in 1912, closed during the war, and reopened in 1920.—(Apr. 5.)

Coal and Lignite in Great Britain and Germany.

Mr. Baldwin, in reply to Mr. Haslam, gave the following statistics of the production of and trade in lignite and coal in Great Britain and Germany in 1913 and 1921:

	United Kingdom.		Germany.	
	1913.	In 1,000's of tons. 1921.	1913.	1921.†
Coal output ..	287,430.5	164,452.5	187,054	134,021
Lignite output ..	—	—	85,831	121,034
Imports of:—				
Coal ..	7.2	3,433.0	10,371	680
Lignite ..	—	—	6,874	2,786
Coke ..	15.6	49.1	583	—
Briquettes ..	1.2	24.4	145	—
Exports* of:—				
Coal ..	73,400.3	24,555.4	34,018	17,962
Lignite ..	—	—	59	37
Coke ..	1,230.0	730.2	6,308	5,230
Briquettes ..	2,053.2	850.1	3,113	744
Home consumption:—				
Coal ..	182,125	130,280	153,000	100,000
Lignite ..	—	—	92,000	123,000

* Exports from the United Kingdom include re-exports.

† Excluding the output from Alsace-Lorraine and the Saar coalfield.

—(Mar. 23.)

Palm Kernels.

Mr. Churchill informed Mr. Ormsby-Gore that the special differential duty of £2 per ton had been applied to palm kernels exported from British West African Colonies to ports not in the Empire in order to encourage the supply of the raw material to British manufacturers. The question of removing the duty would be considered on receipt of the views of the colonial authorities concerned.—(Apr. 4.)

Consumption of Brewing and Distilling Materials.

Mr. H. Young, in reply to Mrs. Wintringham, gave the quantities of materials used in brewing and distilling during the year ended September 30, 1921, as follows:—*Brewing*: Malt, 39,269,430 bushels; unmalted maize, 5040 bbls.; other unmalted grain, 62,961 bbls.; rice and preparations of, 1841.5 t.; maize grits and the like, 47,156.3 t.; sugar, including its equivalent in syrups, glucosio, and saccharin, 93,676.3 t.; hops, 22,713 t. *Distilling*: Malt, 1,133,381 quarters; unmalted grain, 979,403 qtrs.; rice, 374 t.; maize, 1103 t.; sugar, nil; molasses, 13,929 t.—(Mar. 23.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Arsenious Acid.—Industrial white arsenic is produced and refined on a large scale by metallurgical processes, whereas the article dutiable under the Act is prepared by fine-chemical processes and is of higher purity, being required as an analytical reagent, etc.—(Mar. 23.)

Lenses.—All lenses that have worked surfaces or are made of optical glass are dutiable, no matter what their use may be.—(Mar. 27.)

Revenue.—Duties collected under Part I. of the Act from October 1, 1921, to March 25, 1922, total £134,235, including £19,864, £4112, £2540, £3901, £27,607 and £640 collected on goods consigned from France, Italy, Belgium, Switzerland, the United States, and Japan, respectively. Altogether £1500 has been refunded.—(Mar. 28.)

Dutiable Articles.—The list of dutiable articles is being revised in the light of the Referee's decisions in respect of cream of tartar, tartaric and citric acids.—(Apr. 3.)

Fine Chemicals.—The Board of Trade does not admit that the term in the Schedule, "all other fine chemicals," cannot be interpreted. Doubts which have arisen relate only to a limited number of cases of a border-line character, and provision for these is made in the Act itself.—(Apr. 3.)

Development of New Industries.—The object of Part I. of the Act was to encourage the development of the industries to which it relates, and the extension of their range of production to varieties of goods not previously produced in this country. This extension is taking place, particularly in the production of chemical products dutiable under the Act; consequently there is no reason for removing these substances from the lists.—(Apr. 3.)

Delayed Delivery.—When liability to duty cannot be determined at once, delivery can be obtained by depositing the amount of duty to which the goods may be liable. All imported goods are liable to customs examination, and the more detailed examination necessitated by the Act has not added greatly to such costs as demurrage and clearance charges.—(Apr. 3.)

Acetone, as sold, may be made either from acetate of lime or by a fermentation process. Determinative tests of origin are being considered, but should these prove impracticable, the liability of imported acetone to duty must be determined by such declaration by the importer as the Customs may deem sufficient.—(Apr. 3.)

Dumping has been alleged in three instances, under Part II. (1) (a) of the Act, but no *prima facie* cases were made out for reference to a committee.—(Mar. 27.)

Applications under Part II.—There are objections to giving information about complaints which may or may not have been received by the Board pending the decision to refer such complaints to a committee. All complaints are considered without delay, and it is proposed to announce at once the

effect of the findings of a committee which reports against the application; when, however, the Board considers that no *prima facie* case has been made out, the desirability of making a similar announcement is doubtful.—(Apr. 3.)

REPORTS.

REPORT ON THE FINANCE, INDUSTRY AND TRADE OF PERU, DATED OCTOBER 31, 1921. By F. W. MANNERS, *H.M. Commercial Secretary, Lima*. Pp. 42. Department of Overseas Trade. London: H.M. Stationery Office. 1922. Price 1s. 3d.

Minerals.—Owing to the fall in prices and the exhaustion of the richer ores, the copper industry has been working at a loss for some time. The new smelter of the American Cerro de Pasco Copper Co., which had to be erected because only the poorer ores are now available, will probably be finished in August, 1922. Early in 1921 the American Smelting and Refining Co. (Guggenheim Group) acquired an option over large copper deposits at Quiruvilca and Almirante; should the option be taken up a smelter would doubtless be erected and the railway extended, so that the latter would also serve the large anthracite field of Huayday, now lacking transport to the coast. Other American interests have acquired options on or purchased copper-ore deposits.

The Salpo mine (Libertad Department) is the chief producer of silver. Inquiries for silver-lead ore are being received from Germany, payment being offered in sterling. The average annual production of gold during the last 11 years has been 45,623 fine oz., obtained chiefly from the Cotabambas Auraria mine (near Abancay) and the New Chuquitambo mine, north of Cerro de Pasco. A mine at Santo Domingo has been developed but not worked and the prospects of winning placer gold are not encouraging. No further developments in coal mining are recorded (*cf. J.*, 1920, 293 *ii*). Work at the Minas Ragras vanadium mine has ceased and the best and most accessible ore is believed to be exhausted; British interests are considering the exploitation of a large deposit of vanadiferous asphalt containing a high percentage of oxide. Borax and ores of lead, tungsten, molybdenum, antimony and mercury have not been shipped for some time owing to high freight rates and low prices, but a first consignment of bismuth metal has been sent from the San Gregorio mine, near Cerro de Pasco.

The petroleum field near the Ecuador frontier is the only one actually worked, but the Peruvian Corporation is drilling for oil near the line of the Southern Railway, and a London syndicate is testing land between the Negritos and Zorritos fields. Should the dispute between the Peruvian Government and the International Petroleum Co. be settled in favour of the company, a large and untouched field will be brought into production.

The mineral production of Peru in 1919 and 1920 was approximately as follows:—

	1919.	1920.
	Metric tons.	
Copper	39,230	32,982
Vanadium concentrates ..	2,947	9,700
Petroleum and products of ..	348,649	373,280
Coal	344,000	378,000
Silver (fine oz.)	9,833,314	8,516,801

Agricultural Industries.—The strong financial position of the sugar industry has neutralised the low prices to some extent, and now that wages are reduced the producers are ready to

benefit from any increase in price. Since the collapse in the price of wild rubber (the annual shipments of which are now only about 2000 t.), attention has been turned to cotton, but great activity in planting is not to be expected until economic conditions are much better. The cotton crop was 33,558 tons in 1914, somewhat larger in 1920, but probably not more than 30,000 t. in 1921. The castor-oil plant (which grows wild in cotton areas where water is available) is being cultivated experimentally at the State agricultural experimental station. Coca is grown in the Cuzo, Ayacucho, and Huanuco districts, and cocaine is made at Huanuco, about 3300 lb. being exported annually, mainly to Japan. Sisal hemp grows wild in Peru, but is not cultivated, although suitable land exists on the eastern slopes of the Cordillera. The cultivation of vanilla is also worthy of investigation. A firm of manufacturing chemists, the H. K. Mulford Co., of Philadelphia, U.S.A., has sent a mission to search for medicinal plants in the tropical lowlands of Peru.

Trade.—The statistics of Peruvian trade for 1919, the latest available, show that imports were valued at £p.12,200,000 and exports at £p.26,900,000 (£p.1=£1 sterling at par). Among the chief exports in that year were:—Rubber £473,000; wool £1,631,000; hides and skins £291,000; sugar £8,310,000; raw cotton £6,938,000; and petroleum £2,420,000. Of the total exports the United States took 46·5. Great Britain 31·4, and Germany 1·88 per cent. (6·7 per cent. in 1913). The imports included raw materials, chiefly lumber, coal, cement and semi-manufactures of metals, valued at £1,850,000, and manufactures (textiles, paper, soap, perfumery, drugs, machinery, etc.) worth £8,033,000. Since the armistice the share of the United States in the import trade has greatly decreased and that of Great Britain has probably increased; Germany is rapidly increasing its trade in metal goods, cement and dyes, and Japanese competition, though small, is growing. Trade has been stagnant since the summer of 1920 as the prices of the principal Peruvian exports have been below the cost of production, and stocks of imported goods, *e.g.*, paint, linseed oil, iron bars, and aluminium wares have been large. British goods enjoy an excellent reputation in Peru, and textiles, good-class earthenware and glassware are readily sold. At present trade shows signs of revival and though little business is being done, the situation is considered more hopeful.

REPORT ON THE FINANCE, INDUSTRY AND TRADE OF COLOMBIA TO THE END OF SEPTEMBER, 1921. By LIEUT.-COL. G. W. RHYS-JENKINS, *H.M. Commercial Secretary, Bogotá*. Pp. 25. Department of Overseas Trade. London: H.M. Stationery Office. 1922. Price 1s.

The Republic of Colombia possesses nearly 6½ million inhabitants and covers an area of approximately 450,000 sq. miles, of which about one-third is populated and developed to any extent. Natural resources, especially minerals, are abundant. Among the produce exported are coffee, vegetable ivory, tobacco, balata, rubber, certain vegetable oils, cotton, flax and divi-divi; medicinal plants such as quinine, sarsaparilla, ipecacuanha, palmaris, copaiba, and plants yielding dyes, gums, resins, balsams, etc. are exploited, and many varieties of cabinet woods are obtainable. Maize, beans, sugar, rice, potatoes, wheat, etc. are grown for the local market. Livestock constitutes a large proportion of the wealth of the country, and this industry should eventually become very important, as vast areas of grazing land are available. Gold and platinum are the chief minerals produced,

silver is mined, and in the Eastern Cordilleras ores of iron, copper, lead and mercury, and also asphalt, sulphur, alum, saltpetre, coal, quartz, limestone, gypsum, and marble exist in large quantities. The State-controlled emerald mines in the Department of Boyaca are claimed to be among the richest deposits known. Extensive salt deposits near Bogotá are worked by the State and yield a revenue of about £200,000 per annum. Petroleum appears to exist in considerable quantities, and exploitation is said to be possible in an area covering 6000 sq. miles, but only a few square miles, principally in the Carere district on the east bank of the Magdalena river, where three wells are in the experimental stage, can be called proven territory. The petroleum varies from a heavy asphaltic type to a light paraffin-base oil of 41° B_e. Geologists hold that the zones in the middle of the Magdalena valley are well worth exploiting. Varying, but small, quantities of oil have been found in many localities close to the Caribbean and Pacific coasts. Development is hampered because the existing laws are framed to protect national rights in petroleum rather than to attract foreign capital.

Trade in Colombia is still depressed, but the export trade shows signs of recovery. Imports and exports in 1920 were valued at £18,000,000 and £12,000,000, respectively. The only detailed statistics given refer to 1919, when the exports, valued at £7,729,171, included 19,260 fine oz. gold (£56,066), 33,505 oz. platinum (£701,198), and 101,026 metric tons of coffee (£10,858,328). It is stated that merchants are not inclined to continue purchasing from the United States, partly owing to American business methods and partly to the quality of the goods supplied. British goods are preferred, and trade in them could be increased if better credit terms were offered and more Colombian raw materials bought. There are good openings for articles of iron and steel, paint, oils, and paper, which are now obtained mainly from the United States. The demand for chemicals and fertilisers is small.

LEGAL INTELLIGENCE.

ALLEGED INFRINGEMENT OF TRADE MARKS. *The Boyer Co., Inc., of New York v. Farbenfabriken vormals Fr. Bayer und Co.*

In the Chancery Division on March 24 Mr. Justice Eve heard a motion by the Bayer Co., Inc., of New York, for an interim injunction to restrain the Farbenfabriken vorm. Fr. Bayer & Co., a German firm, and its agent in England, Mr. A. C. Henry, from infringing the plaintiff company's trade marks: Helmitol, Luminal, Nesotan, Pro-targol, Tannigen and Theccin; and from selling in this country any drugs or preparations under those names.

His Lordship said that the plaintiff company, when registering its title to the trade marks early in 1920, found that the German company was importing into this country goods bearing the trade marks in question. The German company refused to give an undertaking not to use the trade marks as it would not recognise the exclusive rights of the plaintiff company in this country. The plaintiff company had waited two years before taking action, and it was therefore too late to ask for an interim injunction; but as it was entitled to prevent the destruction of the goodwill attached to the trade marks, facilities for an early trial of the action would be given.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for March 30 and April 6.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Argentina ..	Paper (tender for)	5738/F.W.
" ..	Perfumery, essences	769/371
		F.G./S.C.
Australia ..	Ammonium chloride, porous cells (tender for)	8274/E.D./P.N.
" ..	Artificial silk	378
Canada ..	China, glassware	358
" ..	Galvanised strip	360
" ..	Digester bricks for pulp mills ..	7626/E.D.
		S.C. 2
" ..	Steel sheet, tinplate, lithopone, ground white barytes ..	•
Czechoslovakia ..	Raw materials for soap manufacturers	384
Denmark ..	Window, ground and mirror glass, and clear polished glass ..	5328/F.R.
France ..	Motor tyres and tubes	372
Holland ..	Ammonium sulphate, superphosphate and other fertilisers ..	387
Hungary ..	Steel tubes, ferro-alloys	373
India ..	Perfumery, essences	769/49/
		F.G./S.C.
India, Malaya, Dutch E. Indies, etc. ..	Glassware	365
Italy ..	Soaps, perfumes, metal polish ..	385
New Zealand ..	Iron and steel	381
Serbian Macedonia ..	Cod-liver oil, oil for soap making, tinplate, sheet iron, chemicals, drugs, disinfectants, candles, soap, petroleum, starch, rubber ..	375
South Africa ..	Crockery, glassware, paint, varnish	367
" ..	Leather	368
United States ..	Coko	14992/F.W./S.C. 2

* High Commissioner for Canada, 19, Victoria Street, London, S.W. 1.

TARIFF. CUSTOMS. EXCISE.

Australia.—Application of the revised customs duties on citric acid has been postponed until June 30 and on iron and steel plates and sheets, plain tinned, until September 30.

Belgium.—An export licence is no longer required for cement.

British Honduras.—Imported electric-light bulbs are dutiable at the rate of 5 per cent. *ad valorem* under the British preferential tariff, and 10 per cent. *ad valorem* under the general tariff.

Canada.—The Canadian-French trade agreement has been extended to Algeria, Indo-China, French colonies and possessions, and the territories of the Saar basin.

The regulations controlling the importation of hides and skins, glue stock, bones, etc. have been revised.

Chile.—A tax of 10 centavos per 100 kg. gross weight has been imposed on all goods imported or exported through Chilean ports.

Denmark.—The prohibition on the export of bar silver and yeast has been raised.

The increased customs duties on "luxury" articles will remain in force until May 1. It is not expected that the new Tariff Bill will be passed

during the present session of the Danish Parliament.

Estonia.—The State monopoly of flax and linseed has been suppressed and the export of these articles freed from restrictions. A duty of 5 per cent. on the price is payable on exports of flax.

France.—"Coefficients of increase" have been applied to the customs duties on tiles of compressed cement.

Germany.—The premium on customs duties paid in paper currency has been raised from 4400 to 5900 per cent.

Grenada.—Under the revised list of customs duties, the duties on many articles have been increased from 10 to 12.5 per cent. *ad valorem* (British preferential tariff) and from 15 to 18.75 per cent. (general tariff).

Guatemala.—The importation of ammunition is prohibited.

Japan.—Increased import duties are payable on copper, brass and bronze.

Mexico.—Cochineal, animal and vegetable wax, aniseed, damiana leaves and seeds, indigo, pitch, and the juice of citrus fruits can now be exported free of duty.

New Zealand.—From February 1 the duties and exemptions from duty set out in the recent Customs Amendment Act are applicable in the Cook Islands. The issue for March 30 contains the official definitions of crude petroleum, shale oil, etc. used for customs purposes.

Russia.—The issue for April 6 contains a translation of provisions relating to the customs tariff (to be published separately) for the Soviet and allied Republics.

Sierra Leone.—The duty on exports of palm oil has been reduced from £4 3s. 4d. to £1 0s. 10d. per long ton.

Spain.—Corrections in the new customs tariff are given in the issue for April 6. The corrections affect various ceramic products, certain metals, dyestuffs, essential oils, drugs, and synthetic nitrates. A Bill is to be submitted to empower the Government to modify the new customs tariff so as to provide for reciprocal treatment of goods from countries granting equal advantages to Spanish products, for the imposition of export duties on, or the prohibition or export of, goods if required in the national interest, and for measures to prevent "dumping."

Switzerland.—The State monopolies of the importation of copper sulphate and sugar (raw and refined) are to be abolished from July 15 and September 30 next, respectively. Until then, import licences for sugar will be issued under certain conditions.

Yugoslavia.—Import prohibitions are applied to spirits, artificial butter, candles and wares of wax, soap, etc., perfumes, leather and rubber goods, and certain wares of glass and metals.

TRADE NOTES.

BRITISH.

The Safeguarding of Industries Act and the Prices of British Chemicals.—In view of statements that the Act has had the effect of increasing the prices of chemicals, it is of interest to compare the prices of twelve chemicals made entirely or mainly in this country with those of twelve that are solely or largely imported:—

Chemicals (British).		Value Oct. 1.	Value April 1.
Acetone	85/0 cwt.	75/0 cwt.	
Aspirin	3/2 lb.	2/10 lb.	
Benzoic acid	2/4 lb.	1/6 lb.	
Beta-naphthol	3/6 lb.	2/6 lb.	
Calcium lactate	2/6 lb.	2/0 lb.	
Formaldehyde	95/0 cwt.	74/0 cwt.	
Formic acid	65/0 cwt.	60/0 cwt.	
Methyl salicylate	2/0 lb.	2/4 lb.	
Salicylic acid	1/6 lb.	1/4 lb.	
Sodium hyposulphite	25/0 cwt.	19/6 cwt.	
Salol	2/8 lb.	2/0 lb.	
Chemicals (Imported).		Value Oct. 1.	Value April 1.
Amidopyrin	21/0 lb.	18/0 lb.	
Barbitone	12/0 lb.	11/0 lb.	
Chloral hydrate	5/6 lb.	5/0 lb.	
Gualacol carbonate	12/6 lb.	9/6 lb.	
Hexamine	4/3 lb.	3/0 lb.	
Lithium carbonate	12/0 lb.	10/3 lb.	
Paraldehyde	2/0 lb.	1/4 lb.	
Phenacetin	6/6 lb.	5/3 lb.	
Phenazone	8/0 lb.	7/6 lb.	
Phenolphthalein	4/6 lb.	3/3 lb.	
Potassium permanganate	1/0 lb.	—/9 lb.	
Resorcin	8/3 lb.	7/3 lb.	

An analysis of the above figures shows that the average decrease in value has been about 15 per cent. for both groups. The inference is that the Act has not led to a general increase in the prices either of British or foreign chemicals.—(*Times Tr. Supp.*, Apr. 8, 1922.)

Import Trade of British India.—Statistics supplied by H.M. Senior Trade Commissioner in India show that the value of the imports during the nine months ended December 31, 1921, decreased from 255 to 197 crores (crore=10 mill. rupees=£666,666). Imports from the United Kingdom shrank in value from 155 to 111 crores, those from the United States by 9 to 17 crores, and those from Japan by 11½ to 10½ crores, but imports from Java rose from 12 to 19½ crores owing to heavier imports of sugar. British trade is therefore holding its own, as the American and Japanese shares show a greater proportionate decrease than the British share. Java now ranks second in the Indian import trade, and is followed by the United States and Japan. Imports of coal-tar dyes were reduced from 2.26 to 2.06 crores, and although those from the United Kingdom advanced from 0.55 to 0.58 crores, they were swollen by dyes imported on "reparation" account. Direct shipments from Germany rose from 0.71 to 0.92 crores, and German dyes, favoured by the exchange, are competing successfully in the Indian market.

FOREIGN.

Japanese Camphor.—During 1921 the trade in camphor was depressed, exports attaining a value of only £293,133, compared with £478,448 in 1920 (with the yen=2s. 0½d.). Early in 1922, however, signs of revival became apparent and a contract for 925,946 lb. of crude camphor was made with American buyers. An official of the Japanese Camphor Monopoly Bureau states that Chinese stocks are exhausted and the world market is looking to Japan for new supplies; the consumption is improving, and it is expected that the trade will reach a normal level in the coming summer.—(*Oil, Paint and Drug Rep.*, Feb. 27, 1922.)

THE ARGENTINE MARKET FOR PERFUMERY AND ESSENCES.—H.M. Commercial Secretary, Buenos Ayres, states, in a comprehensive report (D.O.T. 769/37/FG.), that the imports of essences into Argentina during the first nine months of 1920 totalled 62,414 kg., of which France supplied 30, Italy 17, the United States 15 and the United Kingdom 14 per cent. Essences are not produced locally, and are imported by soap manufacturers. Several firms manufacture perfumery, but their products cannot yet compete with the imported article. French perfumes are in most demand; British perfumes are not attractively presented. Imports of perfumery during the period mentioned amounted to 204,736 litres.

REVIEWS.

ORGANIC ANALYSIS, QUALITATIVE AND QUANTITATIVE. By E. DE BARRY BARNETT and P. C. L. THORNE. Pp. xi.+163. (London: University of London Press, Ltd. 1921.) Price 7s. 6d. net.

A COURSE OF PRACTICAL ORGANIC CHEMISTRY. By T. SLATER PRICE and D. F. TWISS. Third edition. Pp. xiii.+239. (London: Longmans, Green and Co. 1922.) Price 6s. 6d. net.

ORGANIC SYNTHESIS. Vol. I. ROGER ADAMS, Editor-in-Chief. Pp. vi.+81. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1921.) Price 8s. 6d. net.

WISSENSCHAFTLICHE FORSCHUNGSBERICHTE. Band III. ORGANISCHE CHEMIE. By DR. R. PUMMERER. Pp. xii.+182. (Dresden und Leipzig: Theodor Steinkopff. 1921.) Price 10s. 9d. net.

(1) The book is intended as a companion to the various works on the preparation of organic compounds, and an aim of the authors has been, by means of systematic tests, to try to prevent qualitative organic analysis merely devolving into "spotting." The ordinary tests for the detection of the elements are first described, after which a somewhat large number of preliminary observations are given, having for their object the separation of the compound into its special class. The succeeding sections deal in detail with various types of organic compounds, classified according to the elements which they contain. Lists giving the usual physical constants and characteristic properties of the most common organic substances are also provided, but these are not exhaustive, as the authors desire to encourage students to refer to the literature. A useful appendix is added explaining how this may be readily accomplished through the medium of the Richter Lexicon. Considerable stress is laid on the need of a quantitative determination of groups as the final factor in the confirmation of an identification. This suggestion, although possibly desirable, is hardly feasible, when one takes into consideration the relatively short time a student has to devote, not alone to this section of his subject, but to organic chemistry as a whole. It is, moreover, a matter of some doubt whether a student would really derive benefit from carrying out some of the quantitative experiments given in the section dealing with preliminary observations, such as the determination of the "bromine value" of a completely unknown compound (p. 27), or the quantitative titration with permanganate of a substance which reduces that reagent in acid solution (p. 28).

The second part of the book is confined to quantitative analysis. Detailed instructions are given for the estimation of the elements and for the determination of molecular weights. The last forty pages contain a description of the methods employed in the quantitative determination of groups and of individual substances, and this portion should prove exceedingly useful, as the importance of such work as an integral part of any routine course cannot be too strongly emphasised. The instructions given on page 101 for the estimation of sulphur by the fusion method could with advantage be amplified.

(2) Only few changes have been made by the authors in the present edition, the aim being rather to keep the text up to date than elaborately to rearrange the subject matter. The preparations are well chosen and include examples illustrating most of the important general reactions. The method of procedure is clearly described in each case, and is followed by a brief description of the properties and characteristic tests of the compound, thus greatly enhancing the value of the preparation. Although originally written for evening students,

now that the book is also largely used in day classes, the authors might consider the inclusion, in a future edition, of a few more typical preparations of a somewhat more difficult nature. Two chapters of the book are devoted to descriptions of the methods employed in the quantitative estimations of the elements and the determination of molecular weights. The final chapter deals with a scheme for the identification of a single compound and should prove useful as an introduction to more advanced work on this subject. The statement on page 223 that "heating with bromine or alkaline permanganate" is a test for an unsaturated compound needs correcting, as also the general observation on page 224 regarding phenols, where it is remarked "these are mostly insoluble, or very sparingly soluble in water (an exception is pyrogallol)." The book is excellently written throughout, and there can be no doubt of its general usefulness for training students in the principles of practical organic chemistry.

(3) Owing to the delay and expense now encountered in America in obtaining organic chemicals from abroad, an editorial board of American chemists has embarked upon the production of a series of pamphlets to be published annually, in which satisfactory methods of preparing various compounds are to be described. The present volume contains full directions, together with a careful description of the apparatus employed, in each case, for the preparation of twenty-three substances. These have been quite arbitrarily chosen, primarily to meet demands from research laboratories. In order to ensure that each set of directions can be readily repeated, every experiment has been carried out in at least two laboratories. Among the compounds described may be mentioned a series of alkyl bromides, allyl alcohol starting from glycerol and technical formic acid, benzoic acid, diacetone alcohol and mesityl oxide, methylene iodide, capryl alcohol, thiophenol, and trimethylamine. No claim is made for originality in most of the preparations, but it is claimed that if the directions are followed, satisfactory yields will be obtained. In every case references to all the methods described in the literature for the production of the substance are given. The pamphlet is admirably printed, and should prove valuable to all engaged in organic preparative work, not only in America, but also in this country where similar difficulties are experienced.

(4) The object underlying the publication of these monographs on the natural sciences, of which this volume is the third, is, as stated in the preface, to present a concise *résumé* of noteworthy research work published since 1914. In this way it is hoped to aid younger research workers, many of whom were separated from all academic work throughout the period of the war, to regain as rapidly as possible their mastery of the subject.

The book is divided into eighteen sections, each dealing in a brief but lucid fashion with a particular phase of organic chemistry. The first two are devoted to a consideration of Schlenk's work on the formation of the alkali-alkyl compounds, the existence of free radicals, and other problems of valence abnormalities. A great diversity of subjects is covered in the following eight sections, among which may be mentioned Dilthey's investigations on oxonium salts, K. Meyer's work on keto-enol isomerism and Dimroth's researches on carminic acid. The succeeding sections, which comprise more than half the book, deal exclusively with the chemistry of natural products, the more recent work on the constitution of caoutchouc, cholesterol and the bile acids, the sugars, and the glucosides being ably presented. Complete sections are also devoted to the investigations of E. Fischer and of K. Freudenberg on the tannins, as also to Willstätter's researches on the constitution and

synthesis of the anthocyanins, whilst the final pages survey this investigator's work on the constitution of chlorophyll and on carbon-dioxide assimilation in the leaf.

The author has condensed a remarkably complete summary of modern research work into this small volume which in no way degenerates merely into a general report, but is highly stimulating throughout. The undoubted value of the book to research workers and to students specialising in organic chemistry is greatly enhanced by the very complete list of references in each section to the original literature. A comprehensive authors' and subject index is provided.

I. M. HEILBRON.

AN INTRODUCTION TO THE STUDY OF METALLOGRAPHY AND MACROGRAPHY. By LEON GUILLET and ALBERT PORTEVIN. Translated by L. TAVERNER. Pp. xvi. + 289. (London: G. Bell and Sons, Ltd. 1922.) Price 30s. net.

The original research work of the authors is sufficiently well known to ensure a good reception to an English translation of their text-book, but apart from this the matter is presented in such an attractive form and illustrated by such excellent photomicrographs that all interested in the subject should secure copies for study and reference. In the introduction, the term "metallography" is given a rather narrow meaning, being defined as the microscopical study of polished and etched metallurgical specimens, whereas the subject is now generally understood to include many other methods of investigation and practically to embrace a complete examination of the constitution and physical properties of metals and alloys. The subject itself, however, is not treated according to the definition given, but a much wider view is taken, a chapter of 61 pages being devoted to the constitution of alloys and the relation between the equilibrium diagrams, the constitution and the physical properties, and a chapter of 41 pages to the mechanical properties and treatment of metallurgical products and the relation between the equilibrium diagrams, the properties and the mechanical treatment. A large proportion of the book is devoted to the industrial application of metallography to steels, cast irons, ferro-alloys and industrial non-ferrous metals and alloys, and contains a large amount of useful information. Several pages are devoted to the industrial metals in which details are given of their physical and mechanical properties and more common impurities, the last-named being illustrated by tables of analyses; it may be suggested that in the next edition these tables be specially drawn up for English readers and analyses given of brands of metals better known and commonly used in this country. Remarks similar to the above apply to the table dealing with the properties, production and prices of the metals, in which British production and prices in pounds sterling would prove more useful than French production and prices in francs.

The second part of the book deals with macrography, which is defined as consisting of the investigation, as a whole, of one or more complete sections which are cut in varying directions dependent on the shape and method of manufacture of the article. The examination is made with the naked eye or, under very low magnifications, by means of a hand-lens, after simple polishing and suitable etching. This is a method of examination about which comparatively little has been published, but which is very extensively used in metallurgical laboratories to investigate the homogeneity of metallurgical products, and also as an operation preliminary to a more minute microscopical

examination in the investigation of causes of fracture and failure in service.

The details and examples given should be a useful guide to all about to take up this fascinating section of metallurgical work. The book appeals to one as being of a thoroughly practical type, and Mr. Taverner is to be congratulated on the excellent translation he has made and on the great care he has evidently taken in seeing the work through the press. The result is a book pleasing in appearance, easy to read, and accurate in detail, which can be thoroughly recommended to all interested in the study of alloys and industrial metals.

C. O. BANNISTER.

PUBLICATIONS RECEIVED.

DICTIONNAIRE ANGLAIS—FRANCAIS—ALLEMAND DE MOTS ET LOCUTIONS INTERESSANT LA PHYSIQUE ET LA CHIMIE. By R. CORNUBERT. Pp. 297. (Paris: Dunod. 1922.) Price, paper 42 fr., bound 47 fr.

LAWS AND REGULATIONS RELATING TO LEAD POISONING. By GILBERT STONE. Pp. 250. Imperial Mineral Resources Bureau. (London: H.M. Stationery Office. 1922.) Price 5s. (Post free 5s. 4½d.)

ZIRCONIUM AND ITS COMPOUNDS. By FRANCIS P. VENABLE. American Chemical Society. Monograph Series. Pp. 173. (New York: Chemical Catalog Co., Inc. 1922.) Price \$2.50.

SOLVENT RECOVERY. Technical Records of Explosives Supply. 1915-18. No. 8. Pp. 22. Ministry of Munitions and Department of Scientific and Industrial Research. (London: H.M. Stationery Office. 1921.) Price 3s. 3d.

LEHRBUCH DER CHEMIE. By PROF. MAX TRAUTZ. Vol. 1. Stoffe. ; Pp. 534. (Berlin and Leipzig: Vereinigung Wissenschaftlicher Verleger. 1922.) Price 22s. 6d.

KOLLOIDE LÖSUNGEN. By JOACHIM LEIMDÖRFER. Pp. 108. (Augsburg: H. Ziolkowsky G.m.b.H. 1921.) Price, paper, 65 mk. (+200 per cent. to English-speaking countries.)

REPORTS ON LAC, TURPENTINE AND ROSIN. Pp. 74. Imperial Institute. Indian Trade Inquiry. (London: John Murray. 1922.) Price 5s.

DIGEST OF COMMENTS ON THE PHARMACOPOEIA OF THE UNITED STATES OF AMERICA AND ON THE NATIONAL FORMULARY FOR 1918. By A. G. DUMEZ. United States Public Health Service. Hygienic Laboratory. Bulletin No. 127. Pp. 356. (Washington: Government Printing Office. 1921.) Price 25 cents.

THE CHEMISTRY OF COMBUSTION. By DR. J. NEWTON FRIEND. Chemical Monographs, edited by DR. A. C. CUMMING. Pp. 110. (London: Gurney and Jackson. 1922.) Price

GAS CHEMISTS' HANDBOOK. Compiled by the Chemical Committee, Technical Section of the American Gas Association. Second edition. Pp. 608. (New York: American Gas Association. 1922.)

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. Department of the Interior. (Washington: Government Printing Office. 1922.):—

TIN IN 1919. By A. KNOFF and B. L. JOHNSON. GOLD, SILVER, LEAD, and ZINC IN COLORADO IN 1919. By C. W. HENDERSON. TALO and SOAPSTONE IN 1920. By E. SAMPSON. IRON ORE, PIO IRON, and STEEL IN 1920. By E. F. BURCHARD and H. W. DAVIS.

COBALT AND ITS USES.

W. R. BARCLAY

The interest which has been aroused of late in cobalt and its compounds has undoubtedly been stimulated by the intensive researches carried out by Dr. H. T. Kalmus and his colleagues under the auspices of the Canadian Department of Mines, and published, both separately and in a number of technical journals, during the last seven or eight years.

Cobalt compounds have filled a valuable place in industry for a century or more, but it is only within the last ten years that metallic cobalt has found any appreciable application, and it is during this period mainly that research work into the possibilities of the metal has been undertaken.

The chief sources of supply of cobalt are found within the British Empire and principally in Canada, where the metal is associated in considerable quantities with silver-bearing ores. Quite recently a promising discovery of ore has been made in Queensland (Australia), in the Cloncurry district near Selwyn. This ore is remarkable in being almost free from nickel and is of a high grade, the concentrate containing from 18 to 33 per cent. of cobalt. It may be of interest to note that contracts for its refining have been entered into by a British firm and that it will be refined in this country.

Metallurgical Treatment.

The metallurgical treatment of cobalt ores calls for little comment since it follows fairly well-known lines, i.e., a combination of "dry" and "wet" processes, in the latter of which cobalt is separated from nickel by precipitation with bleaching powder as sesquioxide (Co_2O_3). The operations are repeated in order to obtain a purer product, and this material—known as "black oxide"—is used as the basis for the manufacture of all other cobalt compounds.

Compounds of cobalt manufactured in this country are mainly the following:—Black cobalt oxide (Co_2O_3), grey oxide (CoO), the carbonate, chloride, sulphate, hydroxide, silicate, phosphate and nitrate.

Uses of Cobalt Oxides and Salts.

The principal uses for these compounds are found in the pottery and enamel trades. They are of great value for colouring—the rich cobalt blue being a valuable factor in decorative designs on domestic china and earthenware—as also for neutralising the yellow tinge in earthenware due to the presence of iron oxide. The quantity used for such purposes as the latter is extremely small (generally of the order of one five-thousandth part), but in the aggregate the amount absorbed by the trade is fairly considerable.

Other uses for cobalt compounds (derivatives of the organic acids, e.g., acetate, oleate, resinate, etc.) are as "driers" in paints made from cheap oils. Mention may also be made of the manufacture of sympathetic ink from the chloride.

Metallic Cobalt.

The metal itself is usually reduced from the gray oxide (CoO) by means of charcoal, at a white heat, by a similar method to that adopted in the production of nickel "rondelles" or "cubes."

Kalmus has suggested its reduction by carbon monoxide, which would be effected at a lower temperature. It can also be reduced with aluminium powder by the "Thermit" process.

Cobalt metal requires further treatment to render it sufficiently malleable and ductile for rolling or

drawing. This can be accomplished by melting the reduced cubes under a borax flux and deoxidising by the addition of pure manganese.

TABLE I.

Physical Properties of Cobalt (Kalmus and Harper).

Property.	Grade.	Cast.	Condition.
	Pure Metal	8.77	Annealed.
Specific gravity ..	Co. 99.73%	..	.. 8.92
Hardness (Brinell)	"	..	.. 121
Melting-point ..	"	.. 1478° C.	..
Tensile strength ..	"	.. 15.35 tons per sq. in.	..
Compressive ..	"	.. 54.5 tons per sq. in.	..
Specific heat between 15° and 100° ..	"	.. 0.1053	..
Electrical resistance ..	"	..	.. 8.96 microhms per c.c.

* Amongst pure metals these values are exceptionally high.

Cobalt has always been to the metallurgist something of a "mystery" metal—a somewhat curious commentary on its name (German *Kobold*, i.e., an evil spirit). Its singular likeness to its older associate, nickel, is itself a phenomenon decidedly misleading. The older generation of metallurgists could surely be forgiven for arguing that given two elements possessing so close a chemical and physical parallel, as shown in Table II, they must surely behave with practical similarity in industrial use.

TABLE II.

Comparison of Properties of Cobalt and Nickel.

	Cobalt.	Nickel.
Atomic weight ..	58.97	58.7
Specific gravity ..	8.8	8.8
Atomic volume ..	6.9	6.7
Melting-point ..	1478° C.	1452° C.

That many metallurgists and engineers did so reason may be implied from a study of published researches into alloys of cobalt, and the results have often led to disappointment, if not futility.

It cannot be too strongly emphasised that in spite of their apparent similarity, cobalt and nickel have many and vital differences, and perhaps in no direction are these differences more clearly shown than in their behaviour as components of alloys.

One of the most striking illustrations of this is to be seen in the alloys of copper with cobalt and nickel, respectively. The addition of nickel to copper, even to the extent of only 10 per cent., produces a marked alteration in the colour of the metal; an addition of 15 per cent. gives a decidedly white alloy; whilst with 20 or 25 per cent. nickel the colour approaches very closely that of pure nickel itself. On the other hand, alloys of cobalt and copper containing even up to 30 per cent. cobalt, still retain the characteristic red colour of copper. The difference is equally striking when the constitutions of the alloys are compared: nickel and copper alloys, in all proportions, showing the simplest possible metallographic constitution, i.e., they are solid solutions throughout their entire range; whilst alloys of cobalt and copper have a very complex constitution and probably give at least four series of solid solutions.

In brief, in the field of alloy metallurgy there is little analogy to be found between the two elements, and conclusions drawn from chemical similarity are liable to mislead. Nevertheless there are some indications that fruitful results may be expected from independent investigations on somewhat similar lines to those which during recent years have led to the introduction of valuable nickel alloys.

The work of Haynes and others in the United States on the alloys of cobalt and chromium, for example, at least reveals the possibility of developing materials of very special engineering properties. The alloy containing about 75 per cent. cobalt and 25 per cent. chromium, known as "Stellite," furnishes a striking example.

A series of alloys of this type, sometimes containing also tungsten and molybdenum, introduced and patented by Haynes is shown in Table III.

TABLE III.

*Cobalt-Chromium and Similar Alloys for High-speed Tools.**

Cobalt.	Chromium.	Tungsten.	Molybdenum.	Properties and uses.
75	.. 25	.. —	.. —	.. Original "Stellite" alloy.
70	.. 25	.. 5	.. —	.. Forges at red heat and takes a good cutting-edge.
60	.. 15	.. 25	.. —	.. Lathe-tools for steel or cast iron.
55	.. 15	.. 25	.. 5	.. High-speed cutting tools said to increase speed of cutting 50-100%, as compared with high-speed steel.
45	.. 15	.. —	.. 40	.. Very hard. Cuts glass and will even scratch quartz.

J. Inst. Metals, Vol. X., p. 404.

So far as non-ferrous alloys of cobalt are concerned, it appears probable that the most fruitful field of research in the future will be found amongst the elements of the highest melting-points. In this connexion the commercial development of the electric furnace for melting metals is rapidly opening the way to industrial investigations into these highly refractory alloys which have not previously been possible.

Ferrous Alloys of Cobalt.

The more immediate possibilities for the development of alloys of cobalt lie, however, in the ferrous alloys. A few years before the outbreak of war, Becker in Germany placed on the market an electric furnace for melting metals which rapidly attracted the attention of engineers. The exact commercial value of Becker's steel as compared with the British and American tungsten, chromium and vanadium steels is a little difficult to estimate, but it has undoubtedly found a place amongst alloy steels, and is largely responsible for the increased consumption of cobalt metal since 1912. But a development promising much greater importance than cobalt high-speed steels, from the point of view of the uses of cobalt itself, is to be found in the recent introduction of cobalt "magnet" steels.

Steels for magneto-manufacture have been, so far, largely either plain carbon steels or chromium or tungsten steels, the latter being generally preferred. An extraordinary increase of magnetic efficiency has, however, been obtained recently with a series of steels containing cobalt in considerable proportions, either with or without tungsten, chromium, etc.

Some idea of the value of these new cobalt steels may be gathered from the figures given in Table IV, which are extracted from a recent paper by Watson (J. Inst. Electrical Engineers, Vol. 59, No. 301, May, 1921, pp. 445-490).

TABLE IV.

Magnetic Properties of Alloy Steels.

Type of steel.	(B.H.) max. Approx. values.	Magnetic data. B rem. Approx. values.	Hc.
6% Tungsten steels ..	250,000 ..	10,000 to 11,000 ..	50 to 60
Chromium steels ..	240,000 ..	9,000 ..	65 to 75
Plain carbon steels ..	200,000 ..	— ..	—
35% Cobalt steel ..	900,000 ..	10,000 ..	200 to 240

The enormous margin in values shown in the foregoing table indicates great possibilities for the development of cobalt magneto-steels, in spite of their considerably greater cost, for this particular factor is to some extent counterbalanced by the

smaller amount of material required and the possibility of simplifying the design of the magnet (J. Inst. Elect. Eng., Vol. 59, p. 452.)

A further use for cobalt lies in the field of electroplating. Kalmus and Harper have shown that cobalt is readily deposited in a bright, coherent form from saturated solutions of the double sulphate of cobalt and ammonium, and also from similar solutions of the single sulphate to which common salt and boric acid have been added. These solutions are excellent conductors and can be worked with extraordinarily high current densities, thus furnishing deposits of metal of appreciable thickness in a very short time.

The published experiments of Kalmus and Harper created very considerable interest in this field mainly by reason of the high rate of deposition as compared with nickel. The hopes entertained by some that, as a consequence, cobalt-plating would be a formidable competitor of nickel-plating have, however, been disappointed, since not only is the intrinsic cost of cobalt a serious obstacle, but also because the costs in electro-nickel or cobalt-plating are made up, to by far the greater extent, of the cost of previous preparation and subsequent polishing, and in neither process can there be any saving when cobalt-plating is adopted. In cases where exceptionally hard deposits are needed, it is possible that cobalt-plating would be of advantage, but it is not likely that this will prove an important use for the metal, although should its price be reduced, the subject would be worthy of careful investigation.

It must, in short, be said that cobalt as a metal has still to make its place in industry, and it is exceedingly difficult to prophesy what exactly that place will be. The present writer feels that it is most probable that ultimately it will prove to have its main value as a component of special alloys, either non-ferrous or ferrous (probably both), but more particularly amongst the most highly refractory materials.

INDUSTRIAL HYDROGEN.*

P. L. TEED.

Twenty years ago the demand for hydrogen was comparatively insignificant, but with the growth of interest in the airship on the Continent (particularly in Germany, where the dirigible soon attained a volume of 500,000 cb. ft.), chemical engineers were led to study the question of its manufacture, and when industrial hydrogen had come into demand for hardening fats, the processes for its production were reduced in number from about 50 laboratory possibilities to less than a dozen commercial methods.

At the time when airships were neither numerous nor large, i.e., not exceeding over 1,000,000 cb. ft. in volume, and when the only important industrial demand for hydrogen was for hardening fats (roughly 4000 cb. ft. of gas per ton of olein converted), the methods in successful operation tended to become restricted to:—(1) Electrolysis. (2) The reduction of steam by metallic iron. (3) Separation of hydrogen from water-gas by liquefaction.

Following the successful commercial utilisation of the Haber synthetic-ammonia process, in which about 70,000 cb. ft. of hydrogen is required per ton of ammonia produced, a method, old in point of discovery, but young in application, came into use. This process, depending on the catalytic oxidation

* Industrial Hydrogen. By Dr. H. S. Taylor. American Chemical Society Monograph Series, Pp. 219. (New York: Chemical Catalog. Co., Inc. 1921.) Price \$3.50.

of the carbon monoxide in water-gas by steam and the absorption of the resulting carbon dioxide by scrubbing under high pressure with water, was rapidly adopted in Germany, where it became of absolutely vital importance owing to the immense demand for nitric acid consequent on the outbreak of war.

By 1914 the numerous methods for making hydrogen had been reduced in most countries to the four already mentioned. If, however, war be regarded as an industry—one in which time rather than cost is the primary consideration—then another method, the "Silicol" process, whereby hydrogen is produced by the interaction of an aqueous solution of caustic soda and ferrosilicon, must be added to the list. With the establishment of trench warfare, the kite balloon became and remained of great value, so that hydrogen had to be provided for filling the balloons (generally of under 30,000 cb. ft. capacity) in the battle-area itself. Two methods of inflation were available, viz., the gas was either derived from high-pressure cylinders or manufactured *in situ* with a portable silicol plant. If cylinders were used the weight to be transported to the place of inflation was about 0.9 lb. per cb. ft. of "free gas," whereas, with the silicol process, the weight of the reagents, neglecting water, was 0.13 lb. for the same volume. Therefore until the helicopter replaces the kite balloon, it cannot be doubted that this method of making hydrogen will be remembered in military circles.

To revert to the genuinely industrial processes; taking the calorific power of coal at 14,700, coke at 13,500, and hydrogen at 62,000 B.Th.U. per lb., and assuming that

$$\text{Efficiency} = \frac{100 \times (\text{calorific power of hydrogen produced})}{\text{calorific power of fuel consumed.}}$$

the efficiencies of the four methods are as follows:—

Process.	Percentage efficiency.	Percentage composition of the product.
Electrolysis	9.0*	H ₂ , 99.7; O ₂ , 0.3
Reduction of steam by iron (Messerschmitt plant, 1916)	19.0	H ₂ , 90.0; CO, 0.5; N ₂ , 0.5
Water-gas liquefaction (Linde, 1914)	22.4	H ₂ , 97.0; CO, 2.0; N ₂ , 1.0
Water-gas (catalytic)	32.8	{ H ₂ , 96.5; CO, 0.2 CH ₄ , 0.3; N ₂ , 3.0

* Assuming a coal-consumption of 1.5 lb. per kw.-hr.

Such is roughly the position of industrial hydrogen to-day. Judged purely on the basis of efficiency, such a comparative table gives an unduly pessimistic idea of the commercial value of the electrolytic method, because the production of saleable oxygen has not been considered. Further, should the necessary electricity be generated, not by steam-driven dynamos, but by water-power, then on the basis on which the other processes were compared, the efficiency exceeds 60 per cent.

The recent book on "Industrial Hydrogen" by Dr. H. S. Taylor gives an impression of up-to-dateness which further examination somewhat modifies. The description of the four chief processes occupies about half the book and one can but feel that had reference been omitted to some of the obviously non-industrial methods, such as the production of hydrogen by using metallic sodium, the information on the truly commercial plants might have been usefully expanded. The chapters on electrolytic methods and on the purification of hydrogen are the best, whilst that on its manufacture by the alternate reduction and oxidation of iron ore is the least satisfactory. In the latter there are several misstatements as to practice and no figures are given of fuel consumption per volume of hydrogen produced. We are told that, in the reduction phase, "opinion is unanimous as regards the necessity of employing gas [water-gas] free as far as

possible from dust and from sulphur compounds"; yet the fact remains that no German hydrogen factory constructed since 1916 has purified the water-gas from sulphuretted hydrogen prior to using it to reduce the ore. The information concerning single retort units is more suggestive of pre-war than of war-time practice in Germany. No mention is made of the Messerschmitt, B.A.M.A.G., and Pirtsch plants constructed since 1914; doubtless the author has found such information difficult to obtain, but he might have avoided an inaccurate statement had he not attached it to "the most recent types of Messerschmitt plant." A reader interested in, but not well informed on, the manufacture of industrial hydrogen will find much interesting matter in this book, but the man with practical experience will not infrequently regret that the author has made his field so wide that its depth has suffered.

MOLASSES FOR FEEDING PURPOSES.

H. C. S. DE WHALLEY.

Hitherto little molasses has been fed directly to stock in this country, but lately the practice has increased. It has now become quite customary for farmers and stock-rearers to purchase barrels of molasses to mix off with their rough fodders from the farm, such as chopped straw, inferior hay, etc., and some remarks on the subject of the comparative values of beet and cane molasses may be of interest.

In "Feeds and Feeding," by Henry and Morrison, the following analyses are shown:—

	Beet molasses.	Cane molasses.
	%	%
Water	23.3	25.8
Ash	5.2	6.4
Albuminoids	3.5	3.1
Carbohydrates	66.0	64.7

Such figures lead one to believe that there is little or no difference between the two types, and the analyses are for this reason misleading.

A few typical analyses made by the writer and some from other sources are given below, and show that there is generally a very distinct difference in composition and value.

	Cuban cane.	English refinery cane.	German beet.	American beet.	English refinery beet.
Water	21.12	24.20	23.84	21.00	20.0
Ash	6.65	6.07	9.60	12.17	10.0
Albuminoids	4.68	1.50	9.57	66.83	70.0
Carbohydrates*	67.55	68.23	56.09		
	100.00	100.00	100.00	100.00	100.0
*Containing:					
Sucrose	35.70	38.00	49.65	50.51	50.0
Invert sugar	18.30	21.50	0.24	0.00	0.5
Non-sugar	13.55	8.73	7.10	—	—
Total sugars	54.00	59.50	49.89	50.57	50.5

Beet molasses are characterised by high ash, high nitrogen, and very low invert sugar. Cane molasses, on the contrary, are usually much lower in ash, lower in nitrogen, and approximately half the sugars consist of invert sugar.

For feeding purposes cane molasses is much preferable to beet molasses. The former has an appetising smell and taste, a low content of alkali salts, and a high content of total carbohydrates, whereas beet molasses has an unpleasant smell and taste, a high content of alkali salts, and usually about 10 per cent. less total carbohydrates.

The sole advantage which can be urged in the favour of beet molasses is its higher content of nitrogenous substance, but as these have been

shown to be mainly amides and some nitrate the advantage is negligible.

The remarks do not apply to meals such as combinations of peat-moss and beet-molasses. During the manufacture of these a good deal of the unpleasant smell and taste is lost, and the alkali salts combine with the humic acids of the peat-moss to form insoluble substances which are excreted without harmfully affecting livestock.

RESPIRATORS FOR FIREMEN.

L. A. LEVY.

A technical paper (No. 248, pp. 61, price 25 cts.) has recently been issued by the United States' Bureau of Mines on "Gas Masks for Gases Met in Fighting Fires," in which is described work undertaken primarily to ascertain the suitability of the American Army gas-mask for use by firemen. The paper contains much information of general interest, and a *résumé* of such experimental work as is novel is given below. The value of the pamphlet lies in this new work, as it is evident that the primary object of the investigation can only be of interest so long as Army canisters can be issued, having regard to the slow deterioration which occurs during storage. The "safe period" has now elapsed, and no respirator canisters to be used for industrial purposes should be taken from surplus Army stores, as their reliability is now seriously open to question.

The canister or purifying chamber of a respirator intended for use in the field is designed to afford complete protection against any gas, in any concentration likely to be employed in warfare, and it must also afford complete protection against particulate clouds—smoke and the like—for civilian purposes. As a general rule it is only necessary to afford protection against one or two specified gases or vapours. It is therefore quite certain that the canister-filling of the British small-box respirator or of the American Army respirator (the filling of which is practically identical with that of the British) can be greatly improved upon should a mask of this type be required for the use of firemen.

The fires, from the fumes of which firemen have to be protected, can be divided into two classes:—

I. Fires in which organic matter ordinarily present in a domestic building or an office is consumed.

This excludes, for example, fires from celluloid, in which oxides of nitrogen are produced.

II. Fires occurring in chemical warehouses or factories, including varnish and other factories.

Class I. (a) The products of combustion of these fires are carbon dioxide, carbon monoxide, a trace of methane, and smoke. The relative proportions of these substances will be affected by such conditions as the free access of air to the fire or a restricted area of combustion. In the former case but little carbon monoxide will be produced and the firemen will only need protection against the smoke and irritant vapour. If the fire is burning in a confined space without access of air, dangerous amounts of carbon monoxide will be formed and the atmosphere will not contain sufficient oxygen for normal breathing.

The Bureau of Mines has conducted a series of experiments on smouldering fires and made analyses of the products of combustion of the different materials burned. The results are given in a table (p. 36). Closely confined spaces, like that of the experimental chamber used, are found in only a few places, e.g., in mines, cellars, and vaults of buildings. In the rooms of buildings above-ground

there is usually sufficient ventilation to prevent a great concentration of the products of combustion, and less carbon monoxide is likely to be found. There is also the general risk of carbon monoxide from broken gas mains.

(b) A different problem is encountered in fires occurring in a building containing a cold-storage plant. In most cases ammonia is likely to be evolved in addition to the ordinary products of combustion. This gas is easily removed by a suitable purifying canister, which, however, possesses the disadvantage that it is useless for protection against any other gas.

Class II. Fires occurring in chemical and industrial factories, in warehouses containing chemicals or products, such as celluloid, which give rise to highly toxic gases on combustion.

In such cases, in addition to the ordinary products of combustion of the organic matter usually present in any building, toxic fumes of great variety are likely to be produced in considerable amount. The problem of providing a suitable respirator in these cases is far more complex. A respirator of the Army type will afford protection against all these toxic substances, provided they are not present in excessively high concentration, a condition which, however, may easily be met with in practice. In addition, ammonia and carbon monoxide may be present, against which an Army respirator affords no protection. There is also the danger of lack of oxygen, especially in vaults and cellars. In such circumstances the only safe appliance is a self-contained oxygen breathing-set as employed in mine-rescue apparatus.

Fires in Burning Mines.—Carbon monoxide is often present in highly toxic amounts in burning mines, and in addition there is frequently the danger of lack of oxygen. The only respirator, apart from a self-contained oxygen breathing-apparatus, which can be used in a burning mine, is a special respirator for carbon monoxide, and this can only be employed if the atmosphere supports the combustion of a miner's lamp.

Carbon Tetrachloride Fire-extinguishers.—The paper draws special attention to the dangerous fumes which may readily be produced when liquids containing carbon tetrachloride are used for extinguishing fires. Such liquids are very effective for extinguishing incipient fires, but the carbon tetrachloride decomposes in contact with the heated body, giving rise to phosgene, hydrochloric acid, and, sometimes, to chlorine in dangerous amounts. If the fire occurs in a confined space without adequate ventilation, the concentration of these dangerous gases may easily become exceedingly toxic, or even fatal, if breathed for only a very short period.

The Bureau has tested the effect of spraying or pouring carbon tetrachloride on heated iron beams and on smouldering fires. The results showed that when 800 c.c. of carbon tetrachloride was decomposed in this manner in a chamber of 100 cu. ft. capacity, a concentration of about 1 in 6000 of phosgene was produced. Such a concentration is absolutely fatal. In addition to phosgene, considerable amounts of hydrogen chloride were also produced.

These experiments clearly indicate that fire-extinguishers containing carbon tetrachloride, unless used in the open or in a well-ventilated place, should only be employed by an operator wearing a gas-mask that contains a filling designed to protect against acid gases.

Conclusions.—A gas-mask with a canister-filling composed of activated charcoal, and provided with an effective filter, will undoubtedly prove of great utility in many cases. It will afford complete protection against the effects of all ordinary smokes, and some protection against many toxic fumes. The mask should never be used when the fire occurs in a confined space owing to the production of carbon

monoxide, against which it affords no protection. Such an appliance is in many respects preferable to the more cumbersome, heavy and complicated, self-contained oxygen breathing-set. The latter, however, must be used when large amounts of toxic fumes are present or if ventilation is very bad.

The paper suggests the use, in a fireman's gas-mask, of a large canister containing special absorbents for ammonia, carbon monoxide, acid gases, and smokes. Such a canister would, however, in the present state of our knowledge of the absorbents required, be extremely difficult to realise in practice. The trouble is that whereas some of the absorbents must contain a certain proportion of water to be effective, the substances employed for removing carbon monoxide will only function satisfactorily if maintained perfectly dry. The difficulty of reconciling these conflicting desiderata will readily be appreciated.

The writer is of the opinion that the respirator referred to above, viz., that with the canister filled with activated charcoal and surrounded with an effective filter for particulate clouds, will be of most general utility. Should such an appliance be inadequate, some form of self-contained respirator must be employed.

SOCIETY OF CHEMICAL INDUSTRY.

NOMINATION OF PRESIDENT AND VICE-PRESIDENTS.

At the April meeting of Council, Sir William Pope presiding, Dr. E. Frankland Armstrong, F.R.S., Technical Director to Messrs. Joseph Crossfield and Co., Ltd., was nominated to succeed Dr. R. F. Ruttan as president of the Society for the year 1922-23. The following were nominated vice-presidents, in succession to Mr. T. H. Wardleworth, Sir John Brunner, Prof. J. W. Cobb and Dr. A. Rée:—Dr. R. F. Ruttan, Prof. G. T. Morgan, Dr. H. Levinstein and Mr. S. J. Pentecost.

Mr. E. V. Evans, hon. treasurer, was elected chairman of the Publications Committee until the Annual Meeting in July next, following the resignation of Dr. C. A. Keane, who has been seriously ill; Mr. W. J. U. Woolcock was nominated a representative on the Federal Council for Pure and Applied Chemistry; and Mr. Julian L. Baker was appointed to succeed Dr. Keane as one of the Society's representatives on the Conjoint Board of Scientific Societies.

NEWS FROM THE SECTIONS.

MONTREAL.

Mr. H. W. Matheson presided at the meeting held on February 20, and Dr. Ruttan was among the 80 members present.

Mr. T. H. Wardleworth announced that the Overhead Council for Canada had been formed, and that the membership was constituted as follows:—Shawinigan Falls: chairman and secretary; Montreal: chairman and ex-chairman; Ottawa: chairman and secretary; Toronto: chairman and ex-chairman; Canadian Pacific: not chosen to date.

Dr. C. E. K. Mees, Director of Research, Eastman Kodak Co., Rochester, N.Y., gave an illustrated address on "Chemistry and the Motion Picture."

The development of the motion picture has depended upon improvements in the apparatus for taking and projecting the pictures and in the sensitive film on which the pictures are recorded.

The manufacture of film starts with cotton which, after washing and drying, is treated with a mixture of sulphuric and nitric acids until it has taken up the right amount of nitric acid, when it becomes soluble. The nitrated cotton is washed to remove excess of acid, mixed with the solvents in large condensers and stirred until completely dissolved. The solution is then coated upon a wheel 20 feet in diameter having a very smooth surface, from which the film is stripped as it is formed by the evaporation of the solvents. The sensitive emulsion is made by precipitating a solution of silver nitrate with bromide derived from the brine wells of Michigan, the silver nitrate being made by dissolving metallic silver in nitric acid. The making of motion-picture film absorbs a significant proportion of the world's production of metallic silver. The silver is precipitated in the presence of gelatin, and the film is passed over a roller into the melted emulsion in such a way that only one side of it becomes coated. On cooling, the emulsion sets to a jelly, and the film is dried, slit to the exact width required for the motion picture (1½ in.), perforated, and packed in rolls of 200 or 400 feet.

The film is of two kinds: the negative film, which is used for taking the pictures and which is extremely sensitive to light; and the positive film, on which the negatives are printed to produce the pictures projected in the motion-picture theatres. The negative film is exposed and developed, usually by winding it upon a rack and inserting in a developing tank. After fixing and washing, the film is dried on huge revolving wheels. The negative is examined and then printed on to the positive film in a "printer" so designed that the intensity or time of printing is automatically varied to compensate for changes in the density of the negative; and the positive film, in its turn, is developed, fixed, washed, and dried. Positive films are then examined and joined together to make the continuous roll of film used in projection, positives often being tinted with a dye or made on tinted base, or the image toned to some colour in order to produce various effects.

The chemistry of the motion picture deals also with the nature of the emulsion and the changes it undergoes on exposure to light, development, and fixing. If a picture be examined under a high-power microscope, the image will be found to consist of tiny grains of black silver resembling masses of coke. These grains are formed during development from the original crystalline grains of silver bromide contained in the emulsion, the effect of light action being to make the silver bromide more easily attacked by the developer, which transforms it into the black metallic silver. The unchanged silver bromide is removed in the fixing-bath, leaving only the black grains of metallic silver to form the final image.

OTTAWA.

At the meeting held on March 10, Mr. F. J. Hambly presided and Dr. J. A. McRae gave an informal account of work he had carried out during the past two years in Manchester University under the direction of, and in collaboration with, Prof. A. Lapworth. The object of the investigation was to prepare derivatives of succinic acid that might prove useful as sources of commercial dyestuffs. As the work is to be published later in the *Journal of the Chemical Society*, Dr. McRae limited his remarks to the general principles involved in the addition of hydrogen cyanide to unsaturated organic compounds. At the conclusion of the paper, it was resolved to invite the Canadian Council of the Society of Chemical Industry and the Council of the Canadian Institute of Chemistry to hold their annual meetings in Ottawa this year during the week of the Royal Society meeting.

AMERICA.

About 50 members and guests attended the meeting held at the Franklin Institute, Philadelphia, on March 24, when the following papers were read:—"A Historical Outline of the Chemical Industry of Philadelphia," by H. Leffman; "Chemical Problems in the Gas Industry," by W. H. Tutwilder; and "Shark-Fishing as an Industry," by Allen Rogers. The meeting was held in Philadelphia in pursuance of a new policy, viz., to arouse interest in different parts of the country other than New York.

BIRMINGHAM.

At the annual meeting of this Section held on March 30, Dr. H. W. Brownson presiding, the following officers were elected for the session 1922-1923:—Chairman, Dr. E. B. Maxted; vice-chairmen: Prof. G. T. Morgan and Mr. F. R. O'Shaughnessy; hon. secretary and treasurer: Mr. G. King. A vote of thanks was passed to Mr. O'Shaughnessy for his services as hon. secretary and treasurer of the Section during the past 17 years.

Prof. A. R. Ling and Mr. D. R. Nanji presented a paper on "The Action of Ammonia and of Amino-compounds on Reducing Sugars": I. "The Action of Ammonia on Dextrose and Levulose." The investigation was undertaken to elucidate the mechanisms of the reactions which occur in preparing "caramel" by the ammonia process. Dextrose combines with excess of ammonia at 35°-40° C. to form an additive compound, glucose-ammonia, which reduces alkaline solutions of copper and silver salts, forming a metallic mirror. On heating to about 100°, however, an exothermic reaction occurs and dark-coloured substances are formed. Glucose-ammonia dissociates in solution, for the specific rotatory power is the same as that of the pure sugar. The sugar obtained from glucose-ammonia consists of a mixture of aldoses and ketoses; in solution it reduces potassium permanganate at the ordinary temperature, a reaction characteristic of γ -glucose. A more vigorous reaction occurs between levulose and ammonia, but the product behaves similarly to glucose-ammonia. The work is being continued. In a further paper, Prof. A. R. Ling, with Mr. W. J. Price, described "A Micro-Kjeldahl Method of Estimating Nitrogen" suitable for determining 1.0-0.1 mg. of that element in substances such as preparations of starch. An amount of the substance known to contain 1.0-0.1 mg. of nitrogen is heated with 1 gm. of potassium sulphate, 0.2 gm. of anhydrous copper sulphate, 8 c.c. concentrated sulphuric acid and 2 drops of a 2.5 per cent. solution of platinum chloride. After cooling the liquid is diluted, boiled to expel sulphur dioxide, made alkaline with sodium hydroxide and distilled. The distillate is made up to a given volume and "nesslerised" under specified conditions.

Mr. R. S. Carter read a paper in which he showed the increasing importance of a knowledge of the hydrogen-ion concentration in many chemical and biochemical processes and discussed the use of buffer salts, the behaviour of indicators and the measurement of the P_H value by the electrometric method.

LIVERPOOL.

Dr. F. J. Brislee read a paper on "Some Chemical Problems of Electrical Industries" at the meeting held on April 7, Dr. E. F. Armstrong presiding.

Many of the numerous materials used in the electrical industries are of indefinite chemical composition. Before any selection can be made the

behaviour of the materials under extremely high electrical stress has to be determined, but in no case can the complete behaviour be ascertained, owing to lack of data. Corrosion and cracking of the lead sheath of cables under certain conditions is one of the problems awaiting solution. This corrosion may be purely chemical, electrolytic, or a combination of both and the product varies from lead peroxide to lead carbonate; formation of the latter is favoured by the presence of weak organic acids and carbon dioxide, derived from decaying organic matter. Cracking is associated with the growth of large lead crystals and takes place along the crystal interfaces; apparently it is favoured by rise of temperature, vibration, and movement due to expansion, contraction, or stress.

Most of the problems arise out of the properties of the dielectric. The need of accurate methods for estimating rubber and of more data regarding the properties of the rubber hydrocarbon is shown by the difficulty of ascertaining the rubber content of a mixture after vulcanisation. The "difference" method leads to errors varying from 0.15 to 24.27 per cent. Methods are also needed for estimating filling and colouring materials, and vehicles of sulphur, such as antimony sulphide.

At this stage the author discussed the methods for detecting and estimating water in dielectrics, and then proceeded to indicate the directions in which further investigations are needed. The chemistry of the hydrocarbons derived from petroleum is a fertile field for future research. The liability of paraffin wax to turn brown and oils to darken on heating in air suggests oxidation, and the increase in acidity is objectionable when the materials are required for electrical purposes. The formation of an insoluble product on heating resin with a petroleum hydrocarbon frequently causes trouble when resin-petroleum mixtures are heated for a long period. A similar phenomenon is observed when resin and paraffin wax are mixed and then heated. The purification of oil by filtration, the nature of the substances thus removed, and the influence of isomers on the resulting properties are subjects requiring careful investigation.

Mr. Allan Merton demonstrated his apparatus for estimating vapour pressures. The annual meeting was held the same evening. Dr. G. C. Clayton and Dr. E. F. Armstrong were re-elected chairman and vice-chairman, respectively, and the following were elected to fill vacancies on the committee:—Prof. E. C. C. Baly, Dr. J. T. Conroy, Mr. A. T. Smith, and Mr. E. Thompson.

CHEMICAL ENGINEERING GROUP.

The report of the hon. secretary, to be presented to the annual meeting on April 28, states that the next conference will be held at Glasgow in July, as a part of the Annual Meeting of the Society, and that the subject for discussion will be "Evaporation and Distillation." The committee of the Group has re-elected Mr. J. Arthur Reavell as chairman, Mr. H. Talbot as hon. secretary, and Mr. F. H. Rogers as hon. treasurer. It is proposed to alter Rule 3 so as to permit an increase in the number of elected members on the committee from ten to twenty. Volume II of the Group's *Proceedings* and a number of data sheets are to be issued almost immediately.

The accounts and report of the hon. treasurer disclose a credit balance of about £58 for the year 1921, as compared with a deficit of £164 for the previous year. This satisfactory result is due to diminished expenditure, for the membership has fallen from 427 to 400. Financial prospects now appear more hopeful, and the committee anticipates a more active development of the work of the Group in 1922 than was possible in 1921.

MEETINGS OF OTHER SOCIETIES.

THE FARADAY SOCIETY.

A joint meeting of this Society and the Oil and Colour Chemists' Association was held in London on March 9, Prof. A. W. Porter presiding. The subject before the meeting was "The Properties of Powders and Grading by Elutriation," and the discussion was adjourned to a further meeting held on March 23.

Prof. T. M. Lowry and Mr. L. P. McHatton, in the opening paper on "The Grading of Powders," discussed existing methods of grading by sieving, air and water-separation, and elutriation, and they described experiments on the grading of barytes and quartz by a vertical flow of water at velocities of 4–8 mm. per second. The separation is much more exact in a tube of 27 mm. internal diameter than in one of 13 mm., and the critical diameter of the particles is also about 5 per cent. greater in the narrow tube. The critical diameter decreases with rising temperature, the temperature-coefficient being 0.4 per cent. per degree. The relation between critical diameter and velocity is given by the formula $\log d = 2.67 + kv$, where k is a constant depending on the diameter of the tube and the temperature of the water. Under identical conditions the diameters are 1.42 times as great for quartz as for barytes, the sectional areas being therefore in the ratio 2:1. This ratio is practically identical with that of the gravitational forces on the particles. The lifting power of the water is therefore proportional to the area of the particle.

Prof. Lowry also described a new elutriator for rapid use. Beswell's elutriator is modified by sealing a long capillary tube into the bottom of the vertical tube, which is tapered smoothly from 25 mm. to 2 mm. The unremoved residue collects in this tube, and is estimated volumetrically by observing the height of the column. The estimation is rapid and very suitable for works' use.

Dr. J. W. French discussed "Abrasion and Polishing Powders for Glass." Abrasion of glass at ordinary temperatures consists in the production of a large number of conchoidal fractures under the impact of fine particles of an abrasive. Remarkably small forces are required to rupture the surface layer of glass, and to form minute cracks, invisible unless the surface be etched. Large pressures produce a conical fracture, and this type of fracture, which results from any pounding action of the grinding tool, must be avoided. It is remarkable that in the common process of abrasion a conical fracture is so rare. The rate of abrasion with suitable grains depends on:—(i) The size of the grains; (ii) the force of impact, which depends on the load on the tool, its speed of translation and its grip on the grains; and (iii) the number of impacts in unit time. The action of grinding wheels is essentially the same as that of loose grains acted upon by a surface-tool, but the rate of abrasion is much less, since the action of a wheel takes place along a line of contact, whereas a surface-tool acts on the whole surface all the time.

In polishing it is essential that the amorphous surface layer of molecules should be ploughed away without applying forces sufficiently great to produce conchoidal splinters. Metallic oxides are frequently used as polishing agents, but carborundum, carbon, and other substances can be used if brought into a suitable physical condition. Final polishing is best done by a thin film of water on pitch. The author concludes that polishing is essentially a physical process, and that the polishing of metals, which has been studied by Sir George Beilby, is not in all respects similar to that of glass.

Prof. P. G. H. Boswell read a paper on "The Separation of the Finer Constituents of Sedimentary Rocks." The author appeals for the standardisation of terms used in grading fine particles (sand, silt, mud, etc.) as a preliminary to the application of quantitative methods, and suggests the adoption of the terms used by geologists in this country and America. Screening is considered unsatisfactory in dealing with particles less than 0.5 mm. in diameter. Below this limit geological materials are usually separated by elutriation in water. Soil analysts in Britain usually adopt separation by subsidence. Stoke's law for determining the velocities of falling spheres has been the basis of both elutriation and subsidence methods. The author discusses the assumptions which have to be made in applying this law to mineral fragments. Mechanical analysis by elutriation or subsidence must be preceded by deflocculation by suitable agents, such as sodium carbonate, ammonia, sodium silicate and soap. The experimental condition that is most important in elutriation is that of maintaining a constant temperature, on account of the changes in both the density and the viscosity of water with temperature. Tap-water is unsuitable for elutriation, and if possible distilled water should be used. Finally, it is desirable that the method of expressing results should be standardised, and the author suggests a graphical method, such as is used in ore-separation, the cumulative percentages by weight of material above certain grade-sizes being plotted as ordinates, and the logarithms of the grade-sizes as abscissæ.

After some remarks by Dr. R. S. Morrell on the value of elutriation to colour-users, Col. Ramsden said that Prof. Lowry's elutriator had been found most useful in grading barytes; it required very little supervision and the residue was only 0.06 per cent., compared with 6 per cent. by the old method.

The adjourned discussion was opened by Mr. C. A. Klein, who pointed out that fine grinding was apt to become a fetish. In most cases there was an optimum size of particle, and he considered that specifications demanding a certain proportion to pass through a certain sieve were useless, since the size of the abnormal particles was a matter of importance. He quoted with approval a recent specification which stipulated that no particles should be more than 10μ in diameter and the average should be 2.7μ . The particles of interest in the paint trade were much smaller than those examined by Dr. Lowry, hence the paint chemist was mainly concerned with the portion of the powder which Dr. Lowry had discarded. In his own experiments he had found the same difficulty due to flocculation and the formation of aggregate, but he did not get such uniform fields as those Dr. Lowry had shown, and he considered that insufficient attention was paid to the abnormal shaped particles. His own experiments tended to show that area rather than diameter was the main factor which determined whether or not the particle was lifted by the current of liquid through the elutriator. With regard to grinding, he found that impact mills tended to produce flattened particles, whereas mills of the ball-mill type produced rounded particles. Mr. Noel Heaton stated that in experiments on grinding glass he had found that the particles retained the characteristic shape of broken glass even down to 3 or 4 μ diameter. Dr. R. Lessing referred to the importance of industrial processes such as coal and ore washing and the treatment of slimes. In designing plant the shape and physical properties generally were of great importance, and he had found that the accepted formulae were not adequate to the tests.

Mr. J. H. Tait stated that in attempts to estimate the amount of cocoa shell in preparations

of chocolate, elutriation methods had so far yielded the most promising results. The main difficulty was that different beans gave very different results, a statement confirmed and partially explained later in a paper on the separation of cocoa nib and cocoa shell by Dr. Whympy, who explained that the raw beans were often treated with clay partly in order to prevent the growth of moulds; the mineral matter was also affected when the cocoa was "alkalised."

Mr. B. A. Kean expressed surprise that sedimentation methods had not been more favourably considered. He considered that elutriation methods were not suitable for fine particles since a sufficiently slow rate of flow was impracticable, and even with sufficiently large particles the apparatus was too sensitive, in view of the uncertainty as to the actual size and shape of the particles. In his opinion Odén's method of expressing results was the most satisfactory.

Prof. Porter, in closing the discussion, said he was surprised that grading by selective centrifuging had not been more thoroughly discussed, as he had obtained good results by it. He hoped that further experiments would be made with Dr. Lowry's instrument, using powders of more widely ranging density and size and with liquids of different physical properties. It was evident that Dr. Lowry's equation $\log d = 2.67 + kv$ was unsatisfactory from the mathematical standpoint since it could be shown that " k " varied with the diameter, and hence " d " was involved on both sides of the equation.

DIESEL ENGINE USERS' ASSOCIATION.

At a meeting held on April 7 in London, Mr. Harold Moore read a paper on "Some Characteristics of Petroleum Oils used in Diesel Engines," in which he gave the results of prolonged investigations on the use of fuel oils in internal combustion engines and furnace-firing installations, together with many analytical data concerning fuel oils from various sources. The author suggests that analyses and records of the behaviour of oils should be collected for future publication, so that in time it may be possible to predict the behaviour of an oil in an engine from the results of its analysis.

Tests used in fuel-oil analysis comprise the following:—(a) Specific gravity, (b) closed flash point, (c) viscosity, (d) cold test, (e) heat value, (f) ultimate composition, (g) sulphur content, (h) spontaneous ignition temperature, (i) ash content, (j) mechanical impurities, (k) water content, (l) Engler distillation, and (m) coke, soft and hard asphaltum. Of these the most useful for the commercial evaluation of fuel oils for heavy-oil engines are (a), (b), (d), (e), (i), (k), and (m). The heat value (e) is not required when it has been previously determined on oils from the same source, and viscosity tests (c) are omitted because viscosity can be estimated with sufficient accuracy by the appearance of the liquid. The tests for coke, hard asphaltum and soft asphaltum, are to some extent a measure of the liability of the oil to carbonise in the engine, and experience has shown that the hard asphaltum or some constituent of it is the real cause of this trouble.

THE PROPOSED INSTITUTION OF CHEMICAL ENGINEERS.

The Provisional Committee held meetings on March 22 and April 5, Mr. W. J. U. Woolcock occupying the chair at the first meeting and Sir Arthur Duckham at the second.

At the first meeting a letter was read from the president of the American Institute of Chemical Engineers, who proposed that the following

facilities be exchanged between the Institution and the Institute:—(1) That each body should print in its year-book the names and addresses of the members of the other body, thus enabling members of both bodies easily to get into touch when visiting the other country; (2) that reciprocal privileges of membership (except that of voting) be accorded in respect of attendance at meetings, visiting works, etc.; (3) that one copy of all publications of each society be exchanged between the secretaries for communication to their members; (4) that copies of the Transactions of the one body be available to members of the other at cost price.

After discussing the first steps to be taken in forming the Institution, it was agreed that the statutory minimum of seven signatories be adopted, and the following gentlemen were elected by ballot as signatories to the documents:—Sir Arthur Duckham, Prof. J. W. Hinchley and Messrs. C. S. Garland, W. Macnab, J. Arthur Reavell, F. H. Rogers, and H. Talbot.

At the April meeting it was agreed that the seven signatories shall be the first Associate Members of the Institution. A small committee was elected to discuss informally the Institution with a committee of the Institute of Chemistry and other steps were taken to ensure the establishment of cordial relations with similar scientific and technical organisations. Pending the first general meeting, when a properly constituted council will be elected, the Provisional Committee was appointed to act as the first council of the Institution, the seven signatories being the legal representatives.

The Provisional Committee and the solicitors have received, in addition to many congratulatory letters, several hundred suggestions for improving the Memorandum, Articles of Association and By-laws; many of the suggestions have been adopted. The Provisional Committee has decided that the initial "I" for "Institution" shall be inserted in the abbreviated titles, and that no abbreviated title be adopted for the graduate class. The steps necessary to register the Institution are now to be taken, and a selection committee has been appointed to draft application forms for membership and to nominate to the first council the first members and associate members. The inaugural meeting of the Institution will be held on May 2, 1922, in the Hotel Cecil, London, and will be preceded by an inaugural dinner.

PERSONALIA.

Mr. S. J. Speak has been elected president of the Institution of Mining and Metallurgy.

Prof. G. Romeo has been appointed to the chair of industrial chemistry in the University of Messina.

Dr. F. Ruppert, of the Institute for Experimental Therapy in Frankfurt, has been appointed professor of bacteriology in the University of La Plata.

The honorary degree of Doctor of Science of the University of Wales is to be conferred on Dr. E. J. Russell, Director of the Rothamsted Experiment Station.

Dr. E. G. Pringsheim, extra-ordinary professor in the University of Berlin, has been appointed to the chair of plant physiology in the German University of Prague, in succession to Prof. F. Czapek.

The American Gas Association has awarded the Beal medal to Mr. F. W. Sperry, Jr., chief chemist to the Koppers Co., Pittsburgh, Pa., for his work on "The Seaboard Liquid Process of Gas Purification."

NEWS AND NOTES.

FRANCE.

Centenary of Pasteur.—We are requested to announce that contributions to the proposed memorial statue of Pasteur (*cf. J.*, 1922, 111 R), to be erected at Strasbourg, *should be sent not later than June 30 next* to the General Secretary and Treasurer, Monsieur Th. Hering, 6, Rue des Veaux, Strasbourg, or to Mr. A. Chaston Chapman, F.R.S., President of the Institute of Chemistry, 30, Russell Square, London, W.C. 1.

Industrial Notes.—**Industrial Alcohol.**—The Comité des Forêts de France is seriously considering the question of producing alcohol from the by-products of the timber industry. About 17 million cb. m. of wood is obtained annually from the forests, and about 40 per cent. of this amount cannot find a market. As a rule the surplus material is carbonised, and about one-half of the cellulose content is thereby destroyed. Various processes are known for converting wood-cellulose into ethyl alcohol *via* dextrose with a yield of 50–70 litres per ton of dry wood, but it has now been shown that this yield can be increased threefold by working on an industrial scale. The Comité realises the great importance of increasing the national output of alcohol, particularly for transport purposes and the production of explosives. Before the war the average yearly production was 1,600,000 hectolitres (33·2 mill. galls.), of which 750,000 hl. was used in making perfumes and chemicals and for lighting and heating, leaving barely one million hl. for internal-combustion engines. This production was attained when all the distilleries were in working order, but at the present time they are working at only 20 per cent. of their former capacity.

The Chemical Market.—Following an improved demand, the chemical market is showing a firmer tone, and the market for painting materials is particularly good. The prices of fertilisers remain remarkably steady, and owing to the shortage of sulphate of ammonia the demand for nitrate of soda is very strong. There are also many inquiries for superphosphate.

Metallurgy.—There is a slight improvement in the demand for semi-finished products, especially those required by the building trade, for with the proceeds of recent loans many new houses are being built in the devastated areas. It is estimated that building now costs about 2·7 times the pre-war price. Prices being very high in Germany, a good trade has developed between that country and France. Belgian competition remains very keen, and British competition, although still strong, especially in hæmatite pig-iron and sheets, is less intense, as the strike in the United States has opened up the South American markets to British products. Exports of iron ore are not increasing, and stocks are diminishing but slowly owing to the limited home consumption.

Coal.—The lower price of coal from the Nord and Pas-de-Calais coalfields and the American strike are leading to an improvement in the French coal market. Competition from Great Britain is less strong, as British coal is being shipped to America, and it is even rumoured that negotiations are proceeding for the export of French coal to the United States. At the end of March the supply of coke due from Germany was only 80–85 per cent. of the stipulated amount.

Committee on the Study of Fertilisers.—The Ministry of Agriculture has formed an inter-departmental committee of 24 members to study from an agricultural standpoint the production, importation and transport of fertilisers, and the raw materials required in their manufacture.—(*Rev. Prod. Chim.*, Mar. 15, 1922.)

The Glass Industry in Eastern France.—Acute depression prevails in the glass industry in eastern France, many factories have been closed since last spring, and prospects are very unsatisfactory. The depression is due largely to competition from Czechoslovakia, aided by the low rate of exchange. Before the war Czechoslovakia possessed over 200 glass factories, and since then three large new factories have been established, and most of the older factories equipped with machinery to replace manual work. The German demand for crystal ware has declined owing to the low purchasing power of the mark, and severe German competition has been felt in the optical-glass industry. Makers of bottles have been adversely affected by the diminished demand for artistic bottles for perfumery and for wine bottles; not only has the use of second-hand wine bottles become common, but the demand is smaller owing to the loss of foreign markets for champagne. Most of the window-glass factories are closed, and it is reported that the French Government is selling foreign glass, bought in 1919 for roughly 20 million francs, at prices with which the French makers cannot compete.—(*U.S. Com. Rep.*, Feb. 27, 1922.)

AUSTRALIA.

The Brown-Coal Deposits at Moorlands, South Australia.—Lignite has been known to exist at Moorlands (86 miles by rail from Adelaide) since 1907, but extensive investigations were commenced only in 1920, and after some preliminary attempts the Tailm Bend and Murray Coal Co. was formed to work the deposit. Numerous bores have been sunk both by the company and the South Australian Government over an area of two square miles, and the Government geologist now reports that the existence of about 2,868,000 tons of lignite has been proved over 130 acres, the seams varying from 11·4 to 21·2 ft. in thickness. Analyses of the cores show the coal to contain, on an average, moisture 50%, volatile matter 20%, fixed carbon 18%, and ash 18%. At present the company holds an area of about 34 sq. miles, and borings have already indicated the presence of three times the tonnage reported by the Government geologist. Following the delivery of trial consignments of 200 tons to industrial firms, orders have been received for a total of 100,000 t. per annum, but the company is awaiting the construction of a branch line to the main line at Moorlands, 3½ miles away, as the high cost of cartage makes delivery unprofitable.—(*Ind. Austral.*, Feb. 23, 1922.)

UNITED STATES.

Patent Fees.—On and after April 19, 1922, the fee payable on application for a patent in the United States will be \$20 instead of \$15 as hitherto, and a supplementary fee of 25 cents will be required for each additional application or patent included in one writing. Applications received after April 19 with a fee of \$15 will be dated from the day when the full fee is paid. Fees for registered designs are not affected.

Lime in 1919.—A total of 3,330,347 short tons of lime, valued at \$29,448,553, and 777,408 t. of hydrated lime, worth \$7,061,146, was sold in the United States in 1919. Of the total production the building trade consumed 35·8%, chemical works 14·2%, agriculture 13·2%, paper mills 10·1%, and metallurgy 8·9%. In the chemical industry the largest consumers were as follows:—Alkali works 136,896 t., calcium-carbide manufacture 140,165 t., bleaching works 27,804 t., for refractories 222,036 t., soap manufacture 29,205 t. Imports, mainly from Canada, increased by 2029 to 8679 t., but exports decreased by 819 to 6372 t.—(*U.S. Geol. Surv.*, Oct. 6, 1921.)

Peat in 1920.—There were no important developments in the peat industry in the United States in 1920, and although the number of producers rose from 15 to 18, the production increased by only 4007 short tons to 73,204 t., valued at \$921,732. In order of importance, the chief producing States were Illinois, New Jersey and California. The quantities used in manufacturing fertilisers (63,272 t.) and cattle food (9182 t.) increased by 8582 and 2780 t., respectively, but the amount dug for fuel fell by 7355 to 750 t. Imports consisted of 2762 t. of peat litter for use largely as packing material, or 495 per cent. more than in 1919, and as there were no exports, the consumption of peat and peat moss in 1920 was 75,966 t., worth \$957,933, compared with 69,661 t., valued at \$721,877, in 1919.—(*U.S. Geol. Surv., Sept. 7, 1921.*)

Strontium in 1920.—No strontium ore has been mined in the United States since 1918 because, although there are workable deposits in Arizona, California, Texas, Utah, and Washington, the native product cannot compete in price with celestite (strontium sulphate) imported from England. During 1920 strontium salts, chiefly the nitrate, were manufactured from English celestite at two plants. No figures of production are given, but it is stated that the total output of strontium salts was greater than that of any other year except 1918. It is estimated that between 1500 and 2500 short tons of strontium ore has been imported annually in recent years; in 1920 not only did imports of ore reach a record figure, but imports of the carbonate and oxide increased by 211·56 t. to 829·55 t.—(*U.S. Geol. Surv., Sept. 17, 1921.*)

BRITISH INDIA.

Forecast of Winter Oilseeds.—The second forecast of winter oilseeds gives the area under rape and mustard as 3,511,000 acres and that under linseed as 2,059,000 acres, representing increases of 25 and 15 per cent. over the revised estimates for the corresponding period of last year. The above forecast applies to provinces containing 98·6 per cent. of the total area under rape and mustard and 99·2 per cent. of the total area under linseed in British India. The general condition of the crops is reported to be good.—(*Ind. Tr. J., Mar. 16, 1922.*)

CANADA.

Mining and Metallurgy.—The Palatin Steel Co., Port Arthur, Ontario, is considering the question of starting operations and of introducing electric smelting of the iron ore. The company's engineers are in Sweden studying the electric process and furnaces. The power would be obtained from the Port Arthur hydro-electric installation at Cameron Falls.

The D'Arcy Exploration Co. (subsidiary of the Anglo-Persian Oil Co.) has closed down the experimental retorting plant at Rosedale, Alberta, N.B., which has been working on the oil shales of that district for about seven months. Mr. John D. Somerville, chemist, representing the Anglo-Persian Oil Co., visited these works last June.

A seam of ankerite of considerable length has been located at Elbow Lake, Pictou County, Nova Scotia, south of the coalfields of that district. The quality of the outcrops is stated to be satisfactory. The extent of the seam has been definitely established, but the depth must be proved before any authoritative statement as to value can be made. The work is being done by the Nova Scotia Coal Co. Ankerite was formerly worked by the Londonderry Iron Company, at East Mines, Colchester County, adjoining Pictou.

The International Nickel Co. is dismantling its plant at Bayonne, N.J., U.S.A., and moving the machinery and equipment to Port Colborne, Ont.,

where, it is stated, all the matte from Sudbury will be refined in future. The Bayonne plant was built in 1880 and has been in continuous operation for more than 40 years. The company's statement for the nine months ending December 31, 1921, illustrates the depression in the nickel business. Actual earnings for the period were \$143,714, as compared with \$4,415,774 for the corresponding period of 1920.

Diamond drilling has shown that in the new area which the Canadian Collieries, Ltd., proposes to develop, the seams have a thickness of 6·5 and 7 ft.

A section at the Union Mine indicates that in this field there are seven seams of coal varying in thickness from 1 to 10 ft. and averaging 29 ft. 3 in. of coal. The area of the Comox field, supposed to be underlaid with coal, is about 90 miles in length with an average width of five miles. Three seams have been mined. The general appearance is more regular than in the Nanaimo field. The coal yields the best metallurgical coke produced from Vancouver Island coal.

Petroleum.—Boring for oil is proceeding with great activity in the Irma, Monitor, Birch Lake and Viking districts of Alberta. Oil has been struck at Monitor on the property of the West Regent Oil Co. The Imperial Oil Co. is drilling ten miles south of the West Regent Well and at 1700 feet struck gas which exploded, followed by fire, which destroyed the rig. The Tapley Arnold Co. and Mud Butte Oil Co. have both started wells in this district. At Birch Lake the Tapley Arnold Co. has 33,000 acres under lease and boring has been started.

At Viking boring operations are held up owing to a controversy between the city of Edmonton and the Northern Alberta Gas Co. as to the ownership of the leases, which were originally reserved for the purpose of supplying gas to the residents of Edmonton. At Irma the Imperial Oil Co. is making good progress with the big rotary rig which arrived last year from Wyoming, U.S.A. This rig is boring on the bank of Battle River about half a mile north of Fabian Station, on the line of Grand Trunk Pacific Railway (C.N. Ry.). A ten-inch hole is down about 2000 ft., but no information is being given to the public. The Boundary Bay and Empire Oil wells of British Columbia have both struck oil. The former yields a light high-grade product resembling Pennsylvania oil, and the latter a heavy black product which yields well on distillation. Boring is proceeding at both wells.

The *Winnipeg Tribune* reports that 10,000 acres, situated in Stony Mountain district, about 15 miles north of Winnipeg, have been leased for oil exploitation by experts representing several United States' companies. Sites for three wells have already been chosen and drilling will commence as soon as the machinery, which is on its way, arrives from Texas and Mexico.

The Pulp and Paper Industry.—Most of the Canadian paper mills are working above 90 per cent. of their capacity. The demand for paper from consumers in the United States is approaching the normal.

The Three Rivers Pulp and Paper Co., of Three Rivers, Quebec, is constructing a plant. The capital of the company is \$3,000,000.

The Great Lakes Pulp and Paper Co. is to erect a large mill at Fort William, Ont., and the estimated cost of the plant is \$2,000,000.

Blotting paper has hitherto not been manufactured in Canada, and imports are valued at about half a million dollars yearly. The Howard Smith Paper Mills, Ltd., of Montreal, is now producing blotting paper of the finest quality. Sir Frederick Becker, of London, has signed a contract with the Chicoutimi Pulp Co. for one million tons of ground wood-pulp and 450,000 t. of sulphite pulp. The

contract is to extend over ten years and the sum involved is over \$60,000,000. The British group of newspaper men interested includes Lords Northcliffe and Burnham. The pulp will be produced at the Chicoutimi, Ha Ha Bay, Valbert and Chandler mills. Sir F. Becker is visiting the pulp mills, in which he has an interest, in the provinces of Quebec and Nova Scotia.

GENERAL.

Sulphur and Iron Pyrites (1913—1919) is the title of a pamphlet prepared by the Imperial Mineral Resources Bureau (67 pp., H.M. Stationery Office, price 1s. 6d.). It contains statistics relating to the world's production and consumption, so far as available, and is compiled with that care which we have learnt already to expect from the Bureau. For many years Italy had practically a monopoly of the world's supply of elemental sulphur but, in spite of a gradual increased demand, a decline in production had set in even before the period now under review owing to competition from the United States and this decrease was accentuated by war conditions. The three largest producing countries are now the United States, Italy and Japan, and the actual production was 491,080 tons, 549,149 t. and 58,493 t., respectively, in 1913, as against 1,190,575 t., 251,213 t., and 66,314 t. in 1919. During the war production increased substantially both in the United States and Japan, the latter producing 116,200 t. in 1917; but with the slackening of the demand at the armistice the Japanese output fell to approximately pre-war level. Other producing countries are Spain with 61,000 t. in 1913 and 83,000 t. in 1919, and to a smaller extent Austria, France, and Chile.

The most important use of sulphur and pyrites is in the manufacture of sulphuric acid but considerable quantities are used in manufacturing sulphite wood-pulp; minor uses are in the manufacture of insecticides, in the rubber industry, etc. The following interesting tables show the production of sulphuric acid in the United Kingdom and the United States and the percentage produced from various raw materials:—

United Kingdom.

Year.	Acid made (100% H ₂ SO ₄). Long tons.	Percentage made from—				
		Pyrites.			Brim- stone.	Zinc and copper fumes.
		Im- ported.	Do- mestic.	Spent oxide.		
1914	1,082,000	88.5	0.45	10.6	0.3	0.15
1917	1,382,000	79.9	0.7	11.0	8.1	0.30
1918	1,130,000	79.4	1.0	11.2	7.4	0.40

United States.

Year.	Acid made (100% H ₂ SO ₄). Long tons.	Percentage made from—					
		Brim- stone.	Pyrites.			Zinc ores.	Copper smelt- ing waste gases.
			Spanish	Do- mestic	Can- adian.		
1914	2,112,000	2.6	50.0	15.8	7.9	13.2	10.5
1917	3,982,000	32.6	22.9	11.8	6.9	18.1	7.7
1918	4,201,000	48.0	7.6	12.7	7.5	16.1	8.1

The manufacture of sulphur from gypsum and andhydrite, as carried out in Germany during the war, is described in an appendix.

The portion dealing with iron pyrites as a source of sulphuric acid again emphasises the large increase in consumption of sulphur-bearing material during the war. Spain and Portugal head the list of exporting countries with a combined total of three million tons in 1913. The greater part of the

pyrites used by acid manufacturers in the United Kingdom is cupreous and is imported largely from Norway, Spain and Portugal and supplies for the Allies were fully maintained during the war from these countries. Before the war the United States imported annually about 1 million tons of Spanish pyrites; this supply was greatly reduced but the shortage was met by increased production from domestic sulphur-mines and largely increased imports of Canadian pyrites. Interesting details are given concerning market prices and the requirements of sulphuric acid manufacturers, and the influence of various naturally-occurring impurities is touched upon. Before the war, iron pyrites of a quality containing from 47 to 50 per cent. sulphur was sold at 21s. 6d. per ton c.i.f. and cupreous pyrites of good quality commanded up to 44d. per unit c.i.f.; these prices are based on a freight rate of about 5s. 6d. per ton.

The African Oil-Palm in Ceylon.—Fruits and nuts of the "Abe-pa" variety of the African oil-palm which had been produced at the Anuradhapura Experiment Station, Ceylon, were sent to the Imperial Institute for examination. The oil-content of the kernels was found to be good, but that of the pericarp was lower than in fruits of the same variety grown in the Gold Coast. In November, 1920, two samples of the green and black varieties were sent for further examination and the results (described in the *Imperial Institute Bulletin* XIX, No. 3, 1921) indicated that, compared with products of the same variety grown on the Gold Coast, the fruits and nuts produced in Ceylon were considerably smaller, the amount of pulp in the fruit was less, and the yield of palm oil, expressed on the dry pulp (66—69 per cent.) was less (77—80 per cent.); the proportion of shell and kernel, however, was roughly the same and the Ceylon kernels yielded 56 to 59 per cent. of fat (dry basis) compared with 51 per cent. from the Gold Coast product. Any difference between the green and black variety was generally in favour of the former, which has slightly larger kernels. The yields of palm oil, although lower than those of the Gold Coast fruits, were satisfactory and the yield of fat from the kernels was very good.

Forecasts of Vanilla-Bean Crops.—According to an official estimate, the yield of vanilla-beans in Madagascar and dependencies for the season 1921—22 is 809,000 lb., and in Réunion and Mauritius 121,000 and 2000 lb., respectively. In Mexico the crop is estimated at 50,000 to 60,000 lb. of whole and 8000 lb. of cut beans, and is the smallest on record, but the prices, \$5.50 to \$5.75 per lb. at the plantation, are the highest paid in Mexico during the last 15 years. —(*U.S. Com. Rep.*, Mar. 20, 1922.)

Radium Monopoly in Czechoslovakia.—A Bill is to be submitted to the National Assembly by the Czechoslovakian Government to give the State the exclusive right of exploiting all radium ores in the country. The State itself will undertake production or will entrust it to private enterprises which will sell the manufactured products to the State. The object of the monopoly is the utilisation of radium for scientific as well as therapeutic purposes. The production at Joachimsthal was 1.1 gm. of radium in 1919, 2.2 gm. in 1920, and 3.2 gm. in 1921 (*cf. J.*, 1921, 371 R). —(*Ch. of Comm. J.*, Apr. 7, 1922.)

The Beet-Sugar Crop in Czechoslovakia.—According to figures quoted in the *American Sugar Bulletin* of February 4, the production of beet sugar during the 1921—22 campaign (October 1—September 30) in Czechoslovakia is estimated at 642,500 metric tons, compared with an output of 761,805 t. in 1920—21. Allowing for 29,090 t. in stock at October 1 last and for a home consumption of

340,000 t., probably 300,000 t. of the 1921-22 crop will be available for export, or 114,376 t. less than in the previous year. The chief exports of sugar in 1920-21 were directed to:—France, 95,528 t.; Hamburg (for trans-shipment), 84,488 t.; Austria, 63,273 t.; Switzerland, 48,429 t.; England, 34,080 t.; and Germany, 23,505 t.—(*Ind. Tr. J., Mar. 30, 1922.*)

The Fertiliser Industry in Sweden.—Of the six fertiliser factories in Sweden, three are situated in the south, in the province of Scania. These three factories employ 603 workmen out of the 868 engaged in the whole industry, and have a total capacity of about 15,000 tons of fertiliser per annum, or about two-thirds of the total Swedish output. Sulphuric acid and phosphate rock are the chief raw materials used, the former being imported from Norway and the latter from America, Africa and Australasia. Preliminary official statistics for 1920 show an import of 117,619 t. of phosphate rock and 96,223 t. of other fertiliser materials, and an export of 96,233 t. of superphosphate. The home consumption of phosphate products has fallen from 675,000 t. during the period 1911-14 to 453,000 t. during the period 1915-18, but although the factories can now meet requirements, high prices have prevented the demand from rising to its normal level. Sweden consumes roughly one-half of its total output of phosphatic products, and exports the remainder to Denmark, Norway, and Finland.—(*U.S. Com. Rep., Feb. 27, 1922.*)

Care of Health in the Bayer Co.'s Works at Leverkusen.—The Bayer colour works are arranged on a modern plan, most of the work-rooms being bright and cheerful and the roads and court-yards large and airy and laid out with flower beds, trees, and lawns. There are 90 comfortable rest-rooms in which the workers can leave their food in special hot cupboards and enjoy their meals. Attached to each rest-room is a dressing-room and a bath-room, and bathing is obligatory at least once a week. There is also a clinic at both Leverkusen and Elberfeld under the supervision of five doctors; all workers enjoy free medical treatment, and their families can attend without charge on certain days in the week.

The German Potash Industry in 1921.—Figures published by the "Kaliprüfungsstelle" give the German production of potash salts in 1921 as 9,241,179·1 metric tons (1,066,848·7 t. K_2O), the decrease of 2,145,259·4 t. as compared with 1920 being due to the lack of demand during a great part of the year. The production in 1921 originated as follows:—Hannover 2,912,997·1 t. (334,426·1 t. K_2O); Stassfurt 1,989,829·5 (215,499·4 t. K_2O); Halle-Mansfeld-Unstrut 1,134,791·1 t. (114,389·7 t. K_2O); Süd Harz 1,746,430·6 t. (231,719·8 t. K_2O); Werra 1,457,128·1 t. (170,818·7 t. K_2O). Production and sales of potash products during 1921 were as follows:—

		Production.	Sales.
		Metric tons.	
Crude salts	.. 12-15% K_2O	.. 1,085,757·9	.. 2,064,122·7
Carnallite	.. 9-12% "	.. 262,675·2	.. 27,775·2
Manure salts	.. 18-22% "	.. 329,081·3	.. 343,293·6
" "	.. 28-32% "	.. 88,603·2	.. 88,453·5
" "	.. 38-42% "	.. 752,312·2	.. 800,194·2
Potassium chloride	.. 50-60% "	.. 354,435·5	.. 365,900·2
" "	.. over 60% "	.. 77,655·8	.. 43,512·3
Potassium sulphate	over 42% "	.. 44,628·0	.. 43,512·3
Potassium magnes- ium sulphate	..	.. 11,709·1	.. 12,213·0

The demand was small during the first half of the year but improved in the last quarter. The total sale for the year was 3,745,551·7 t. of potash salts (921,561·6 t. K_2O), of which 3,181,530·2 t. was disposed of in Germany. Exports amounted to 564,021·5 t. (152,838·1 t. K_2O), a slight improvement compared with 1920. By a contract made in October, German potash salts were again placed on the United States market, and Holland, Scandin-

avia, England, Austria, and Czechoslovakia began to purchase, but there was no revival of demand from the vast agricultural areas of eastern Europe, and sales to southern Europe were limited. Competition was felt, especially in the American market, from Alsatian potash, of which the output totalled 895,744 t. of crude salts (146,355 t. K_2O) in 1921; figures of sales, however, are not yet available. Competition from Spain, where potash deposits were discovered shortly before the war, is not feared owing to difficulties of extraction.

Wage-groups and Piece-work in the German Heavy-Chemical Industry.—The following grades are now recognised in the tariffs at present ruling in the German heavy chemical industry:—Metal workers; building mechanics; foremen of mechanics; mechanics; foremen of skilled trade workers; skilled trade workers. The following are paid time-wages:—Foremen of unskilled workers; unskilled workers; forewomen; workwomen; and young persons of both sexes under 20 years of age. Piece-work is occasionally done by the unskilled workers.

The abolition of piece-work after the Revolution lasted only a short time; by the tariffs agreed to in 1920 and still ruling, it is allowed with certain restrictions. "The fixing of piece-work rates is left open to mutual agreement with the understanding that in certain cases of dispute the workers' committee is to be consulted. The piece-work rates must be calculated so that the average worker can earn more than the agreed time wages." In the latest tariff agreements this has been made still more precise, so that the average worker must earn at least 15 per cent. more than time wages. Thus to-day there is no limit set to piece-work rates. On the whole, piece-work is now as general as before the war, although the workers do not like it.

Manufacture of Cyanamide in Rumania.—The transfer of a portion of Transylvania to Rumania under the Trianon Treaty has given the Rumanian Government possession of a large chemical factory and an important cyanamide plant. The factory, constructed during the war to manufacture synthetic ammonia and nitric acid, is situated near Dicio-San-Martin, where abundant supplies of natural gas, containing 99 per cent. of methane, and of calorific value 8000 gm.-cal. per cb. m., are available. At present the supply of gas piped to the factory from Soras, 11 km. distant, averages 450,000 cb. m. per hour, but it could be greatly increased. Under a long-term contract for the supply of gas, the cost of fuel (assuming par values of currency) works out at about 0·08d. per kw.-hr., and the total power required is 31,270 h.-p., of which 28,000 h.-p. is used for the carbide furnaces.

The process of manufacture is as follows:—Powdered carbide contained in small metal boxes with perforated bottoms is passed slowly through four tunnel-furnaces (each 45 × 1·7 m.), heated at the entrance end to 800° C. by natural gas. Nitrogen passing into the furnace at the other end meets the hot carbide and combines with it to form cyanamide, enough heat being generated by the exothermic reaction to complete the transformation. In passing through the last 12 m. of the furnace the heat given off by the cooling cyanamide serves to warm the in-coming nitrogen. The nitrogen is obtained from the products of combustion of the natural gas by removing oxygen with heated copper, carbon dioxide with lime, and water by freezing-out. Ammonia is produced by heating the cyanamide, after treatment with water, in an autoclave under a steam pressure of 10-12 kg. A plant has not yet been erected for the catalytic oxidation of the ammonia, which is now sent to the Blumau powder factory in Austria for that purpose. During the war the plant consumed annually 24,000 metric tons of lime,

18,000 t. of coal, and 4000 t. of electrodes, representing a value of about 48 million lei (£1,920,000 at par).

Soda, chlorine and chlorates are also manufactured in the factory, from rock salt (obtained locally) by the Billiter process, in an electrolytic plant with a capacity of 75 t. of chlorate per 24 hrs. The availability of chlorine and methane suggests that methyl chloride, chloroform, alcohol and acetaldehyde will eventually be manufactured also. —(*Chim. et Ind.*, Jan., 1922.)

The Coal-Tar Dye Industry in Russia in 1920-21.—In 1913 and 1914 the production of coal-tar dyes in Russia was carried on mainly by 10 firms, and the factories situated in present-day Soviet Russia (excluding the Kuban district, the Ukraine, and Siberia) produced about 8000 long tons. To-day the industry is controlled by a Bureau for Aniline Manufacture which in 1921 supervised seven factories, of which five, employing 385 workers and 123 officials, were in operation. The erection of one of these, the Dorogomilow factory, was begun in 1920 but was not finished in October, 1921. At the end of 1920 the Rubeshansk factory was provisionally organised for the production of the more important dye-intermediates. The number of workers and officials in all the factories in 1920 was 325 and 171 respectively, or 171 and 20 short of the numbers required to execute the programme of production drawn up at the beginning of that year. This programme was seriously interrupted by delays in delivery of raw materials, and although work never actually ceased, production was restricted to articles which could be made from materials in stock. As it was not possible to control the production of the raw materials—aromatic hydrocarbons—the factories had to be satisfied with the small supplies of these remaining in the hands of the State.

The fuel supply presented great difficulties in 1920, but better results followed the institution of State control in the latter half of the year. Of the factories under the Bureau, that at Kineshma was especially well supplied with fuel. In the Moscow group, the Derbenewsk factory was the only one that could obtain even moderate supplies of fuel; the others were unable to procure wood fuel, and it is stated that the Trigor factory had to burn a fence in order to deliver 1444 lb. of β -naphthol required by the Derbenewsk factory. The output in 1920 of the "nationalised" factories under the Bureau for Aniline Manufacture was as follows (pood=36.113 lb.):—

	Actual output, lb.	Percentage of planned production.
Nitro- and sulpho- compounds ..	72,226	52
Aniline	—	—
Toluidine	36,113	25
β -Naphthylamine	—	—
Basic dyes	—	—
Sulphur dyes	180,565	100
Azo dyes	108,339	48
Alizarin (20 per cent.)	—	—
Sodium sulphide	72,226	34
Nitric acid	108,339	23
"Nowarsolan"	216,678	15

The estimated productive capacity of these factories in 1921 was as follows (pounds):—Intermediates 802,707, sodium sulphide 10,834, azo dyes 361,130, alizarin (20 per cent.) 433,355, Nowarsolan 722, nitric acid 2,166,775, basic dyes 10,834, sulphur dyes 29,490, saccharin 2167.

Official German statistics show that in 1920-21 Germany exported 143.5 metric tons of coal-tar dyes through the Baltic to Russia and 236.8 t. to Finland, most of which found its way into Russia; in the last quarter of 1921 the quantities were 304.7 t., and 49.8 t., respectively. In 1913 Russia and Poland imported 169,810 t. of coal-tar dyes worth 3.5 million marks, including 329 t. of alizarin and alizarin dyes values at 1.8 million marks.

LEGAL INTELLIGENCE.

BREACH OF CONTRACT FOR THE SUPPLY OF TNT. *The Clayton Aniline Co., Ltd. v. The Crown.*

On April 3 in the King's Bench Division Mr. Justice Sankey heard a petition of right by the Clayton Aniline Co., Ltd., claiming damages from the Crown for breach of contract in respect of the manufacture of trinitrotoluene for use in the war.

For the suppliant company it was stated that the Crown had admitted the claim under a first contract for £19,548 for 800 tons of TNT at 1s. 6d. per lb., and had paid the money into court. By a later contract the Ministry of Munitions agreed to take the company's total output of TNT for the period of hostilities, subject to a month's notice, but not before June 30, 1917. Payment was to be at the rate of 1s. 6d. per lb. up to an output of 70 t. per week and 1s. 9d. per lb. for a weekly output above 100 tons. The second contract began at the end of the first contract in July, 1917. The suppliant company claimed that the Crown had broken the contract by ordering the company, on May 15, 1917, to reduce output to 40 t. per week, although new plant had been laid down to reach the maximum output, and on June 20 to cease production entirely. The Crown said that output was reduced by agreement, but admitted that it broke the contract by ordering production to stop, and had paid into court damages based on an output of 40 t. a week for a month. The suppliant company, however, claimed damages based on a weekly output of 74.5 t., the amount made until production had to be reduced to 40 tons. The reason suggested for the reduction was to lessen danger to explosion in a closely-populated area, but the commercial manager of the company thought that it was because the Government factory at Queensferry was producing all the TNT required.

For the Crown it was stated that a representative of the Ministry of Munitions asked the company to reduce output to 40 tons per week; if the company had not accepted it would have been given a month's notice to cease production.

In giving judgment, Mr. Justice Sankey said that he was satisfied that the suppliant company did not agree to reduce production, and that its story was correct. He therefore gave judgment that the company was entitled to £22,368, in addition to sums paid into court, with costs.

COMPLAINT TO INCLUDE INCANDESCENT GAS-MANTLES IN THE SCHEDULE OF DUTIABLE ARTICLES UNDER PART I. OF THE SAFEGUARDING OF INDUSTRIES ACT.

In the King's Bench Division on April 7 the Lord Chief Justice, Mr. Justice Sankey and Mr. Justice Greer heard a special case stated under Section 19 of the Arbitration Act, 1889, relating to the true construction of the Safeguarding of Industries Act (*cf. J.*, 1922, 12 R). The Incandescent Mantle Manufacturers' Association and the Thorium Manufacturers contended that the Board of Trade should have included gas-mantles in the schedule of articles liable to import duty, and that the Official Referee should have defined the goods on which duty was to be levied, and complained that he had not done so. The National Gas Council associated itself with the Board of Trade in opposing the inclusion of gas-mantles in the Schedule.

Section I. (4) of the Act runs as follows:—
"Where the imported article is a compound article, of which the article liable to duty under this section is an ingredient or forms a part, no duty shall be charged under this section in respect of the compound article if the compound is of such a nature that the article liable to duty has lost its identity."

Counsel for the Association contended that a gas-mantle was a compound of thorium and cerium, neither of which had lost its identity.

In his judgment, the Lord Chief Justice said that the Referee had power to alter the wording of the decision he had given on December 10, 1921, to that which he gave on December 21. The Referee was right in stating a case upon a point of law for the opinion of the Court, and it was quite within his power to refuse to include incandescent gas-mantles in the Board of Trade list. He (his lordship) did not agree that "compounds" in the Schedule meant the same thing as "compound articles" in Section 1. (4) of the Act. The compounds of thorium and cerium were not manufactured articles which contained thorium and cerium.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Subsidies for Industry.

Answering Mr. Acland, Mr. Bridgeman said that the Government was opposed to any policy of subsidising industry on the ground that economic trading was the only sound basis for regaining national prosperity. The only form of assistance available for industry was that provided by the Trade Facilities Act.—(Apr. 6.)

Trade Facilities Act, 1921.

Mr. Young said, in reply to Sir H. Nield, that over 500 applications for guarantees had been received by the Advisory Committee appointed under the Act, and the Treasury had decided to give guarantees in respect of 15 applications representing a total sum exceeding £15,000,000. A statement would be presented to Parliament showing the names of the companies that were affected and the sums involved.—(Apr. 7.)

Home-Grown Sugar.

In answer to Mr. A. Fell, Sir A. Boscawen said that during the winter season, *i.e.*, when there was least employment in country districts, 800 to 900 men were employed at the Kelham and Cantley sugar factories. These factories worked continuously and the amount of labour employed could not be judged by the actual period during which the factory was working. It was estimated that some 800 additional labourers were employed by farmers growing sugar-beet during 1921.

Mr. Young, answering Capt. W. Benn, said that excise duty was levied on sugar, not on sugar-beet. No duty due in the last financial year had been remitted, nor had any announcement to that effect been made.—(Apr. 10.)

Dyestuffs (Import Regulation) Act.

In reply to Mr. Kiley, Mr. Baldwin said he was aware that the Chemical Merchants' and Users' National Vigilance Committee had passed a resolution demanding the repeal of the Dyestuffs Act and the Safeguarding of Industries Act on the grounds that they had not achieved the results anticipated and had caused much loss of time, money and prestige, and if continued would divert trade and increase unemployment. He did not accept any of these statements and would take no action.—(Apr. 10.)

Mr. Newbould asked whether the refusal to grant a licence to import German dyes for tinting and colouring cinematograph films was driving the industry abroad. Sir W. Mitchell-Thomson said that British dyestuffs were being used for tinting and

colouring films with satisfactory results. The film-makers should inform the British dye-makers how far the British dyes were unsatisfactory for the purpose.—(Apr. 12.)

"Reparation" Dyestuffs.

Mr. Baldwin informed Mr. Lyle-Samuel that, during the period December, 1919, to March 31, 1921, the total value of "reparation" dyes received from Germany was £549,094 and the amount realised from sales was £380,062.—(Apr. 10.)

Sir W. Mitchell-Thomson stated, in reply to Major M. Wood, that the selling prices of German "reparation" dyes were fixed after consulting the manufacturers and consumers and approximated as closely as possible to current market values.—(Apr. 12.)

"Reparation" Coal.

Replying to Mr. Hurd, Mr. Bridgeman said that, although the value of deliveries of German coal was reckoned on the German pithead price for the purpose of reparations account, the price in France and Belgium was fixed by the Governments of those countries sufficiently high to avoid competition with home-produced coal. But for the reparation arrangements, German coal could have been sold in the open markets of Europe at prices against which British coal might have had difficulty in competing. The French Minister of Finance had recently stated that all the fuel delivered by Germany to France had been allotted for consumption in France.—(Apr. 10.)

Gas for Airships.

Answering Capt. Bower, who asked whether he was aware of the new process for manufacturing a non-inflammable gas called "Currenium" which gave approximately the same lift as hydrogen and could be produced much more cheaply than helium, Mr. Amery said that the Admiralty was watching experiments with non-inflammable substitutes for hydrogen as a filling for airships.—(Apr. 12.)

Export Credits.

In a reply to Mr. Kiley, Sir W. Mitchell-Thomson said that, during the year ended March 31, 1922, advances totalling £1,078,109 had been made and applications sanctioned for guarantees amounting to £8,572,629 under the export-credits scheme. Of the latter sum, guarantees had been given for £686,520.—(Apr. 12.)

Safeguarding of Industries Act.

On the motion for the Easter adjournment, Mr. Asquith raised the question of the administration of the Act and claimed that it was scouted by the business community at large. The schedule enumerated some 6000 commodities of which about 2000 were chemicals; many of these chemicals were not, nor had been, produced in this country, yet they were classed under "key" industries. Out of the 400 or 500 appeals against items in the lists only 10 or 11 had been heard or decided. This constituted a great obstacle to the free course of business and showed the impossibility of administering legislation of this kind. Great difficulty had been experienced in defining the terms "fine chemicals" and "synthetic organic chemicals" and he asked the President of the Board of Trade if he could introduce something more lucid. The delay in deciding complaints under Part II was causing serious hardship to producers, distributors, and the public. It would only be fair that those who had paid duty and subsequently established that the goods were not dutiable, should have a refund.

Mr. Kiley observed that most of the commodities affected by the Act were raw materials necessary for British industries, and that from 70 to 75 per

cent. of the fine chemicals imported were for re-manufacture or re-export. The result was that trade was diverted abroad and traders had to open branch establishments in Hamburg and elsewhere. Much of the recent development in the chemical industry was due to the war and not to the Act.

In reply Mr. Baldwin said that, having regard to the depression of trade and the large stocks in hand at the time when the Act was introduced, there was no cause to be dissatisfied with the progress made. Distinctly cheering reports were coming in from the fine-chemical industry; firms that were discharging men and working short time when the Act became effective were now working full time, progress had been made in research and in the creation of a body of skilled investigators and workers in those industries. The manufacture of scientific and optical instruments was progressing and scientific glassware was being made on a larger scale and of improved quality. Of the many complaints sent in, probably only a very small proportion would come before the Referee. The hearings did not involve the Board of Trade in heavy costs, but if people complained—and they probably expected to benefit if they should succeed—it was no severe penalty for them to pay for it. Under the Act the Board could not make any refunds. Three cases referred to committees under Part II of the Act had been reported upon unfavourably and four cases had not been decided. The delay was unfortunate, but if an Order were made, the House could not find time to ratify it until after Easter.—(April 12.)

Dutiable Articles.—Inquiry is being made as to the liability to duty of glass tubes used as containers for pills. The sugar-coating of pills is dutiable under the Finance Act, 1901; but the makers are invited to furnish confidential information on the other ingredients to facilitate the analysis and to expedite the decision as to the liability to duty.—(Apr. 10.)

Synthetic Camphor.—As the complaint that synthetic camphor has been improperly included in the lists of dutiable articles is now being heard, the cost of the case cannot be stated, nor would it be proper to discuss the merits of the issue.—(Apr. 10.)

Complaints.—The process of adjudication provided by the Act was designed to avoid unnecessary expenditure. Complainants who incurred heavy costs did so on their own initiative and could not claim repayment although their complaint had succeeded.—(Apr. 12.)

Customs Clearance.—The suggestion cannot be adopted that the shipping documents and, if necessary, a sworn declaration by the importer are sufficient proof of liability to duty to enable the Customs to give release and delivery quickly.—(Apr. 12.)

Containers. such as casks, are not dutiable, but the statutory value of goods dutiable on an *ad valorem* basis is the price paid by the importer for the goods delivered at the port of importation and would therefore include the cost of containers or packing.—(Apr. 12.)

Customs Charges.—No charge is made by the Customs for opening packages to ascertain liability to duty, but the Post Office levies a fee of 6d. per parcel, in addition to ordinary charges, for clearing parcels through the Customs and collecting the duty. The fees received do not cover the cost of the services.—(Apr. 12.)

Scheduled Articles.—In drawing up the lists of dutiable articles the Board of Trade obtained technical advice from the Government Laboratory, Patent Office, and other sources. The relatively small number of complaints to be heard by the Referee seems to show that the lists were based on adequate technical information and further technical advice is not needed.—(Apr. 12.)

COMPANY NEWS.

BRITISH CELLULOSE AND CHEMICAL MANUFACTURING CO., LTD.

The accounts for the year ended June 30, 1921, show a working loss of £758,415, and including preliminary expenses, £305,095, and inaugural expenses, £120,862, a total debit balance of £1,099,305. Goodwill, patents and patent rights figure among the assets at £1,885,000; debentures, of recent creation, amount to £166,500, and the total issued share capital is £7,750,000.

To extinguish the debit balance and to provide further working capital, the directors propose to reduce the face value of the ordinary shares from £1 to 10s. (and therefore the share capital to £6,000,000), and to charge the entire assets of the company to secure debenture stock for £500,000, which will be subscribed by a holding company at par, will bear interest at 8 per cent., and be redeemable in 20 years' time at par, or at any time on six months' notice at 105. The Cellulose Co. will pay to the holding company an annual sum based on the value of the sales. Existing debentures will be redeemed, so that the issue will leave £336,800 of new money, a sum sufficient to enable the company to attain an output of 3 tons a day of artificial silk.

The British Government has consented to the scheme, and has agreed to transfer, without consideration, one-half of its preference shares (£1,450,000) to the company which is subscribing for the new debentures. The preference shares are not to be cumulative until after February, 1923.

On the technical side, the report states that new difficulties arose in dyeing the cellulose-acetate silk towards the end of 1921, and that these have not yet been overcome, although other difficulties have been surmounted. The Fabrique de Soie Artificielle de Tubize, of Belgium, has, after a thorough investigation, confirmed in the main the views of the directors, and will underwrite £100,000 of the new debentures, lend one of its most capable works managers, sell the silk in foreign countries, and buy cellulose acetate from the British company. The Färberei u. Appretur Gesellschaft vorm. A. Clavel u. F. Lindenmeyer will manage the company's dyehouse at Spondon for two years, or less, and train the staff; and the inventors of the process will make concessions which should increase the prospective sales of the company's products.

LEVER BROS., LTD.

At the 28th annual general meeting held on April 6, Lord Leverhulme was able to congratulate the shareholders on the excellent results obtained by the parent company and its associated 157 companies in the year 1921. These results he ascribed in the first place to the virtues of co-partnership, but also to many other causes, *e.g.*, the fact that every unit in the combination has a sound commercial and financial record. Interests in associated companies are valued at £48,000,000, but no value has been put upon holdings in the West African companies. Lord Leverhulme criticised very strongly the refusal of H.M. Government to permit the immigration of Hindoos and their families to the Solomon Islands, where the company owns vast coconut plantations, and also the fiscal policy of the Colonial Office in West Africa. He called upon the Government to repeal all export duties and to reduce drastically the import duties, and commented adversely upon the excessively high railway charges on the West African railways. The sum of £250,000 has been placed to special reserve, £2,871,924 expended out of profits on advertising, depreciation, renewals and repairs, and £1,336,361

distributed to co-partners as dividends. These sums total over £3,394,000, and compare with £228,000 (10 per cent., against 20 per cent. in 1920) paid in dividends to the ordinary shareholders. Lord Leverhulme was equally optimistic concerning the future. Sales during the first quarter of 1922 show a phenomenal increase over those for the corresponding period of 1921, export trade is slowly recovering, living costs are down, and so also are interest charges and wages.

The net profit for the year was £4,035,515 (£3,270,091 in 1920) on an issued share capital of £46,982,000. During 1921, £4,000,000 of 7 per cent. first mortgage debenture stock was issued at 92½, and a further issue to reduce floating debt is under consideration, but holders of the stock have agreed to the proposal that future issues shall carry a lower rate of interest and be redeemable at an earlier date than originally provided for.

ALBY UNITED CARBIDE FACTORIES, LTD.—This company is now in liquidation. The unsecured creditors will receive only a fraction of their claims; preference and ordinary shareholders will receive nothing. Overcapitalisation, absence of reserves, and a bad contract for power were the main causes of the *débâcle*.

REPORTS.

REPORT ON ECONOMIC AND COMMERCIAL CONDITIONS IN THE DOMINICAN REPUBLIC AND THE REPUBLIC OF HAITI, DATED OCTOBER, 1921. By C. K. LEDGER, *H.M. Chargé d'Affaires, Santo Domingo City* and E. D. WATT, *H.M. Chargé d'Affaires, Port-au-Prince, respectively*. Pp. 59. Department of Overseas Trade. London: H.M. Stationery Office. 1922. Price 1s. 9d.

The Dominican Republic is rich in unexploited minerals. Veins of gold are said to occur in the Cordillera Central and the natives win gold from alluvial sands in many districts. Copper ore occurs in the Provinces of Santo Domingo, Azua, Monte Cristi, and La Vega; iron ore is found on the banks of the River Maimon, manganese ore near Puerto Plata and in the Seibo, and nickel ore near Bonao and La Vega. Five petroleum concessions have been granted, but serious work has been started only at Higuerito-Agua Hedionda, near Azua.

Timber of every kind, including lignum vitae, yellow-wood, logwood, etc., abounds in the mountainous regions, but remains almost untouched owing to the absence of roads. Sugar, cacao, tobacco, and coffee are the chief agricultural products. The sugar industry was extremely prosperous during 1920, the crop of 177,649 long tons being the highest on record, and the price twice that of the average. The crop for 1921 is estimated at 195,071 t., and expenses on the sugar estates are being reduced. The yield of cacao in 1920 increased from 22,018 t. to 29,972 t., but sales of both cacao and tobacco were small and the coffee crop was ruined by the drought.

Exports in 1920 were valued at \$58,731,241 and included 158,804 metric tons of sugar (76 per cent. of the total exports), 219 t. of beeswax and 1891 t. of dyewoods; 87.03% of the exports went to the United States, 5.2% to France, 3.32% to Canada and 1.4% to the United Kingdom. Of the total imports, valued at \$46,525,876, the United States supplied 77.5, Porto Rico 13.1, and the United Kingdom 3.3 per cent. The imports included:—Cement \$412,355; chemical and pharmaceutical products \$1,018,557; earthenware and porcelain \$274,140; glass \$254,877; paints and pigments \$410,593; perfumery, etc. \$296,062; and soap \$701,485. Among the imports from Great Britain

were soap \$13,064, chemicals \$11,167 and perfumery \$958. A regular direct steamship service would greatly help British trade.

Haiti.—During the fiscal year 1920-21 trade was almost at a standstill. The decline of the export trade to Europe led to a corresponding decrease in the import trade, which seriously embarrassed the Republic, as State revenues are almost entirely derived from import dues. The latest statistics are for the year ended September 30, 1920, when exports were valued at \$18,990,032 (U.S. currency), of which the United States took 52.15, France 34.39 and the United Kingdom 1.68 per cent. Among the exports were:—Cacao 1987 t.; logwood 108,106 t.; sisal 254 t.; honey 1,365,198 galls.; sugar 3135 t.; lignum vitae 4564 t.; cottonseed oil 133 t.; and iron ore 80 t. Imports were worth \$27,393,411 (U.S. \$3.12%, United Kingdom 8.35%, France 5.3%), and included 34,201 barrels of cement, 446,115 lb. of chemical and pharmaceutical products, and 3199 t. of soap. The principal imports from the United Kingdom are textiles, metal goods and some earthenware, but at present there is no demand. The only industrial development recorded is the establishment near Port-au-Prince in 1917 of a sugar factory with a capacity of 2000 t. of cane per 24 hours.

REPORT ON THE ECONOMIC AND FINANCIAL SITUATION IN URUGUAY, AT NOVEMBER, 1921. By CAPT. E. C. BUXTON, *H.M. Commercial Secretary, Montevideo*. Pp. 40. Department of Overseas Trade. Price 1s.

The Republic of Uruguay, the smallest in South America, has an area of about 72,180 sq. miles and a population of about 1,500,000. Sixty per cent. of the area is devoted to stock-raising, and under 6 per cent. to agriculture. Apart from meat-canning, there are few industries and of these the leather industry is the most important. Two breweries and a few match factories supply local needs, and the manufacture of tiles, bottles, cement, soap, candles, paper, etc. also employs a fairly large amount of labour; the cement is well spoken of, but the cheaper German cement is imported extensively. In addition to the electric-power station at Montevideo, the State controls a large chemical works, the Institute of Industrial Chemistry (*cf. J.*, 1921, 258 n), in which are manufactured sheep-dips, acetates, sulphuric and nitric acids, gun cotton, collodions, ethers, ammonia, benzol, sodium bicarbonate, soda crystals, sulphites, bisulphites, etc. It is proposed to make the manufacture and sale of alcohol a State monopoly. To encourage the establishment of new industries, plant and machinery are exempt from import duties and certain reductions in taxation are allowed.

Exports during 1920 were valued at \$80,751,720 (£1=\$4.70 at par) and consisted mainly of animal products such as meat, skins, hides, fat (3600 t.), tallow (4734 t.), bones and bone ash (17,268 t.); 25 per cent. was shipped to the United States, 22 to the United Kingdom, and 15.85 per cent. to France. Of the imports, worth \$18,164,912, the United States supplied 30.52, Argentina 21.72, and the United Kingdom 17.23 per cent. Trade with the United Kingdom and the United States was restricted by the unfavourable exchange, so that Germany secured a large amount of business. Heavy stocks accumulated during 1920, but were liquidated to a large extent in 1921. Large supplies of glass and china are being imported from Belgium, Germany and Czechoslovakia, and German chemicals, drugs, dyes, iron and steel products, cement, pottery, etc. are on the market. British goods have a favourable reputation, but importers are now not only limiting orders but are paying special attention to prices (*cf. J.*, 1921, 415 n).

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for April 13 and 20.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Argentina ..	Industrial chemicals	427
" ..	Heavy chemicals	451
Australia ..	Iron, steel, cement	430
Belgium ..	Iron, steel, non-ferrous metals, refractories, soap	412
Brazil ..	Potash, resin, caustic soda	428
Bulgaria ..	Lubricating oils, etc. (tender for)	7799/F.E./S.C.
Canada ..	Heavy chemicals, zinc oxide, oils	436
Germany ..	Iron, steel	413
Holland ..	Iron and steel	442
Italy ..	Wood-pulp, soya beans, oils, grease, tallow, chemicals	414
New Zealand ..	Tiles, earthenware	411
Persia ..	Glass bottles	437
Spain ..	Perfumery, drugs	421
Sweden ..	Gums, resins, wax, vegetable dyeing and tanning materials	445
United States ..	Oils, colours and other materials for the margarine and soap industry	446
	High-carbon steel	15032/F.W./S.C.2

TARIFF. CUSTOMS. EXCISE.

Argentina.—The Budget Commission proposes that the valuation tariff be revised and the customs tariff law be modified so as to reduce the duties on articles for national consumption and increase the duties on "luxury" articles. It is thus proposed to reduce to 5 per cent. *ad valorem* the duty on steel and raw materials for use in factories and to reduce to 25 per cent. *ad valorem* the duty on certain leather goods, red lead, lead pipes, etc.

Australia.—The exportation of metals, alloys, and minerals is prohibited save by permission of the Minister for Trade and Customs.

Austria.—A new customs tariff, based on the former Austro-Hungarian tariff, is under preparation. It is expected that duties paid in paper money will be increased by about 50 per cent. Information on the proposed new classification of tariff categories, such as fats and oils, iron and steel, etc., may be obtained from the Department.

Belgium.—A law has been passed to protect Belgian industry from German competition in certain classes of goods.

Cuba.—In the proposed new tariff the duties are, in general, from 20 to 25 per cent. higher than those of the present tariff. The duties on certain foreign produce competing with local manufactures, *e.g.*, soap, will probably be doubled or trebled.

Danzig.—Under a convention made between Danzig and Poland the former has the right to import certain quantities of the following goods at reduced rates of duty before September 30:—Cement, tiles, bricks, soap, paint, lithopone, and other materials. The convention also provides that raw materials, semi-manufactures and finished goods imported by Danzig manufacturers shall be admitted free of duty.

France.—Acetone and crude and rectified methyl alcohol may now be exported without special authorisation. The "coefficients of increase" applied to the duties on artificial-silk yarn have been reduced, and those affecting the duties on "table glass" are not to be applied to glass bobbins for making artificial silk.

Gold Coast.—Opium, morphine and similar dangerous drugs may not be imported unless required exclusively for scientific and medical purposes.

Italy.—Raw linseed oil imported for industrial purposes other than the preparation of foodstuffs may be admitted at the reduced rate of 10 lire (gold) per 100 kg. If the acidity, calculated on oleic acid, is not less than 4 per cent., the raw oil may be imported at the above rate without being denatured.

Kelantan.—The import duty on matches has been revised.

Portugal.—Imports of printing and lithographic paper are now dutiable at the rate of 0.4 centavos per kg.

South Africa.—Regulations have been issued controlling the sale and quality of milk products (condensed milk, etc.) and prohibiting the sale in the Province of the Cape of Good Hope of any food containing formaldehyde or any preparation thereof.

Spain.—It is proposed to increase the import and consumption duties on sugar, glucose, liquid caramel and similar products.

Switzerland.—The export duty on scrap iron has been reduced temporarily from 40 to 10 centimes per kg.

Tunis.—Sugar may now be imported and sold without restriction.

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.—The Board of Trade has issued a list of goods which may not be exported from the United Kingdom cancelling all similar lists issued prior to April 1. The goods affected include: ammonium sulphate; basic slag; cocaine, diamorphine, ecgonine, morphine and opium; salts and substances containing not less than 1 per cent. of cocaine, diamorphine, ecgonine, morphine and opium; explosives (with certain exceptions); fertilisers; compound manures containing either ammonium sulphate, calcium superphosphate, or basic slag; and calcium superphosphate.

Open general licences have been issued permitting the export to all destinations of ammonium sulphate and compound manures of which ammonium sulphate is the only constituent whose exportation is prohibited, and permitting the export to the Channel Islands of basic slag, calcium superphosphate, and compound manures containing either of these two fertilisers.

THE SAFEGUARDING OF INDUSTRIES ACT.—The following corrections in the lists of articles dutiable under Part I of the Act are notified by the Board of Trade:—

The following are deleted:—Acid gallic, acid tannic and acid gallotannic, alum chrome and chrome alum, aluminium sulphocyanide and thiocyanate, R anthracene, antimony fluoride, antimony potassium tartrate, potassium antimony tartrate and tartar emetic, barium chlorate, R barium peroxide, barium sulphocyanide and thiocyanate, R calcium biphosphate, calcium ferrocyanide, chromium oxide, chromium sulphate, copper sulphocyanide and thiocyanate, hydrogen

peroxide, magnesium silicofluoride, mercury oxide, R naphthalene, ænanthic ether, phenalgine, pinene, potassium perchlorate, sodium chromate, sodium perborate, sodium perchlorate, sodium permanganate, sodium silicofluoride, tin oxide.

Insert the prefix "R" before:—Ammonium phosphate, copper oxide, hæmatoxylin, methyl-ethyl ketone, potassium bisulphite, potassium permanganate, sodium acetate, sodium phosphate, tri-, titanium oxide.

Replace "Acid acetic, 80 per cent. grade or higher" by "Acid acetic glacial" and for "R calcium phosphates" read "R calcium phosphates (other than R calcium biphosphate)."

TRADE NOTES.

BRITISH.

Canadian National Exhibition.—The forty-third annual Canadian National Exhibition will be held in Toronto from August 26 to September 9. H.M. Trade Commissioner Service will conduct a bureau of information, and the Commissioner at Toronto will be glad to receive trade literature for distribution from the bureau. Catalogues of crockery, glass, chemical plant, scientific instruments and similar products, small exhibits typical of United Kingdom industries, and small posters would be suitable for this purpose. The Exhibition is an excellent medium for trade and it is hoped that this year more United Kingdom manufacturers and merchants will exhibit or take advantage of the facilities provided. Further information can be obtained from the Department of Overseas Trade (Canadian Section), 35, Old Queen Street, London, S.W. 1.

Swaziland in 1920-21.—Exports in 1920-21 amounted in value to £143,192, and included:—Cassiterite tin, 366 tons; gold bullion, 276 fine oz.; cotton, unginned, 184 t.; and wattle bark, 46 t. The total volume of trade was slightly below the normal. The crop yields were generally fair; about 1000 acres was planted with cotton, and with reasonable prices and better facilities for marketing this industry should be successful, especially as attention is being given to the development of a longer staple and to preventing the introduction of disease. Tin is the only mineral worked commercially at present and the output has declined from 418 t. in 1919 to 410 t. in 1920. Very little work was done at the gold mines owing to the heavy costs. The imports include sugar, spirits, oils and mining machinery.—(*Col. Rep.-Ann.*, No. 1102, 1921.)

FOREIGN.

Trade of Chile in 1920.—In 1919 the small demand for nitrate of soda greatly reduced the value of exports from Chile, but in 1920 nitrate was exported in record quantity, so that the normal excess of total exports over total imports was re-established. The exports in 1920 were valued at 791,521,373 pesos (gold peso = 1s. 6d. at par), and the chief items were as follows (gold pesos):—Coal and fuels 853,092; metallic minerals 100,601,750; nitrate and iodine 535,602,880; other minerals 19,196,736; and chemicals 1,001,553. The chief importing countries were the United States (43·5%), Great Britain (20·8%), France (4%), Holland (2·6%), and Argentina (2·2%). The exports to Germany, worth 7,480,844 pesos, were probably copper and other metals, foodstuffs, etc. as there was no German market for nitrate. Imports increased in value to 455,078,934 gold pesos, the United States supplying 30·9% (against 48% in 1919) and Great Britain 25·4% (19·4%). After textiles, chemicals are the

chief import, the value imported in 1920 being 52,276, 533 pesos (say, £3,900,000), compared with 39,444,531 pesos in 1919.—(*U.S. Com. Rep., Suppl.*, 1922.)

The Chemical Trade of France.—The following statistics show the chief exports and imports of chemicals from and into France during the calendar years 1920 and 1921:—

	Metric tons.		Metric tons.	
	Exports.	Imports.	Exports.	Imports.
	1921.	1920.	1921.	1920.
Nitric acid	497·4	1,303·4	972·6	696·7
Sulphonitric acid*	563·9	134·3	195·4	149·9
Potassium nitrate, crude	865·4	763·4	0·9	32·4
.. .. worked up	54·3	22·7	622·9	1,488·8
Sodium nitrate*	73·9	556·5	19·7	501·3
Ammonia, common	433·2	202·2	2,888·4	1,947·1
.. .. commercially pure	4·8	17·0	97·8	347·0
Ammonium sulphate, crude	3,409·7	640·4	51,875·3	27,557·7
Boric acid	1,570·7	833·6	38·2	322·4
Borates	1,726·6	1,838·1	3,946·7	7,166·6
Calcium carbide	5,850·2	5,324·5	2,333·2	3,840·4
Carbon bisulphide*	784·7	554·9	0·1	2·3
Sodium cyanide*	600·3	779·9	4·1	6·9
Potassium ferrocyanide	414·4	333·9	1·9	42·4
Chlorine, liquid	2,574·0	13·3	78·7	117·5
Hydrochloric acid	47·4	1,673·4	1,511·4	2,470·6
Chlorates	720·8	2,066·4	1,036·3	987·4
Calcium chloride	3,204·9	4,163·6	2,378·9	6,795·0
Sodium hypochlorite*	748·1	394·5	7·3	1·1
Hydrogen peroxide	402·5	485·2	118·8	68·1
Sodium phosphates*	471·9	301·0	165·0	164·8
Sodium and potassium silicates	198·7	501·6	144·0	414·2
Sulphuric acid	8,752·8	14,560·4	5,878·0	7,657·6
Sulphur dioxide, liquid*	460·8	381·8	559·6	420·0
Sodium hyposulphite	724·2	436·4	9·0	243·0
Sodium sulphide*	1,430·0	1,167·8	725·6	5,974·4
Alumina, anhydrous	4,078·2	8,657·1	880·3	6·2
Aluminium sulphate	521·8	1,522·2	485·1	1,698·0
Alums, ammonium and potash	102·1	223·8	620·1	1,000·6
Antimony oxide*	545·9	336·2	3·0	35·5
Antimony sulphide	168·3	188·1	67·5	314·8
Barium dioxide	143·6	0·5	51·9	608·6
Barium carbonate	28·3	20·3	1,244·1	2,260·4
Barium chloride	854·3	633·4	708·3	1,687·9
Barium sulphate	499·7	595·5	456·9	1,702·8
Barium sulphide*	0·8	0·9	535·5	111·5
Calcium carbonate, pptd.	481·1	481·2	1,177·1	1,439·7
Calcium chloride*	58·1	116·0	2,503·1	3,520·4
Dichromates of sodium and potassium	38·5	215·9	1,555·0	3,923·3
Copper sulphate	3,392·6	3,898·8	15,411·2	16,141·8
Iron oxides	2,311·1	644·4	1,234·4	1,791·0
Iron sulphate	572·5	1,036·1	922·9	696·9
Magnesia carbonate	22·8	31·7	744·7	2,057·0
.. .. chloride	53·5	66·6	617·5	1,571·6
.. .. sulphate	62·4	110·7	251·9	4,452·7
Sulphates of magnesium and potash	22,986·0	278,688·4	—	—
Lead carbonate	246·0	503·0	3,104·1	4,540·9
Lead oxides	593·8	571·2	551·4	1,504·4
Potassium hydroxide	321·8	653·5	1,536·4	633·1
.. .. carbonate	11,589·5	1,335·4	1,776·	2,039·9
.. .. chloride	125,786·8	182,745·5	8,245·7	1,924·7
.. .. sulphate	936·3	243·2	1,616·9	1,457·7
Sodium chloride, refined	31,947	25,531·9	3,086·4	5,410·0
.. .. other	35,805·3	83,134·2	40,778·5	37,831·2
.. .. hydroxide	18,267·6	23,852·9	451·5	3,603·0
.. .. carbonate, crude	16,001·7	31,878·6	6·2	242·1
.. .. other	54,892·9	61,916·1	563·1	4,065·3
.. .. bicarbonate	1,392·0	1,318·5	31·9	207·6
.. .. sulphate	—	14,656·7	1,011·1	1,785·6
Zinc oxide	2,140·0	2,776·0	3,270·5	5,550·2
Lithopone	23·4	152·6	2,712·5	8,990·9
Coal-tar oils, toluene, cresols, etc.	1,841·7	4,260·4	7,450·0	35,199·3
Coal-tar oils, heavy	474·7	85·3	6,601·6	2,997·6
Benzols	48·3	1,034·4	52,243·4	36,648·8
Glycerin	2,908·7	3,691·5	60·2	1,146·0
Acetone	120·4	46·3	1,102·4	700·3
Acetate of lime	255·1	117·4	0·1	1,621·2
Tartaric acid	431·1	695·3	174·5	234·9
Potassium tartrates	6,512·3	9,261·4	3,063·0	7,287·3
Oleic acid	1,753·5	1,120·6	1,903·6	4,631·5
Stearic acid	635·8	475·6	1,150·9	2,852·0
Oxalic acid	4·7	5·6	121·4	523·1
Citric acid	291·4	182·8	148·8	162·1
Citrates	3·3	4·7	190·0	921·0
Aniline, toluidine and derivatives of	68·4	165·5	55·3	544·8
Saccharin*	271·5	137·5	—	—
Tanning extracts	30,248·6	27,379·0	4,363·0	28,453·3
Superphosphates	63,323·9	17,641·2	36,937·2	43,300·3
Basic slag	312,223·7	17,908·7	31,522·3	31,110·6
Sodium nitrate	6,959·8	2,338·8	303,403·2	261,364·0
Calcium nitrate and cyanamide	191·5	1,132·9	5,026·5	11,692·1

* New product.

—(*Rev. Prod. Chim.*, Mar. 15, 1922.)

REVIEWS.

PULVERISED COAL.

PULVERISED COAL SYSTEMS IN AMERICA. By L. C. HARVEY. *Special Report No. 1, Fuel Research Board. Revised edition. Pp. 117. (London: H.M. Stationery Office. 1922). Price 5s. net.*

THE PREPARATION, TRANSPORTATION AND COMBUSTION OF POWDERED COAL. By J. BLIZARD. *Report No. 564, Mines Branch, Department of Mines, Canada. Pp. 131. (Ottawa: Government Printing Bureau, 1921).*

Many recent advances in fuel technology have resulted from a realisation of the very important bearing of the physical structure of a solid fuel upon its behaviour during combustion. All large-scale reactions involving solid and gaseous phases present special difficulties to the chemist, and modern developments in connexion with pulverised coal, "colloidal" fuel, and certain compressed patent fuels with a uniform granular structure, are evidence of efforts being made to surmount those difficulties and to secure for the combustion of a solid some of the advantages of gaseous firing. There are, of course, other stimuli at work upon the inventive faculties. Many fuels must pass through some cleaning process before they are available for certain purposes, and prior to cleaning they must be crushed to a greater or less degree. The possibility of distilling a powdered fuel has often fascinated the chemist who is studying problems of carbonisation, and it would appear that some of the solid residues from such a process are particularly suitable for use in pulverised-fuel burners. Furthermore, the gradual exhaustion of some of our more valuable coal-seams and the marked change in the economic conditions of the coal industry have focussed attention upon those very raw materials for which some preliminary treatment is essential because of their lower quality.

Mr. Harvey's descriptions of American practice in the application of pulverised coal are already well known. The revised edition of the Report of the Fuel Research Board brings our information up to date, and the record of progress made is a striking indication of the economic advantages which are being established. In dealing with the pulverising and distributing systems accessory to the various furnaces, attention is directed to the dangers of coal-dust explosions, and the author is apparently satisfied that if the teaching of past experience is applied to the design of modern plant, the risk involved is negligible. Special consideration is also given to the factors affecting the control of the type of flame and the efficiency of combustion within the furnace.

A mere description of the technique of pulverised fuel would have been of direct interest only to a relatively small circle in this country where little development has taken place except in the Portland-cement industry. Mr. Harvey's report is, however, much more than this. It covers a wide field, and refers to a number of proposals bearing upon, and arising out of, the main subject in a manner which will arrest the attention of all those interested in general fuel problems. It is very significant that, after pulverisation, coals of high ash-content can be burnt with efficiencies approaching those obtained with the best coal. The fundamental reason for this appears to be the elimination of ash from the combustion zone of the furnace, and designers should give more attention to this matter because, in many installations, the major part of the ash is dispersed up the chimney-shaft. To permit this on a large scale would inevitably create a new smoke problem for large cities, whatever may be the experience regarding the absence of complaints in connexion with isolated installations.

Mr. Blizard's report on the same subject will be of value, particularly to the engineer interested in the details of plant design. Full particulars are given relative to the sizes of various pieces of apparatus, the heat required for drying the coal, and the power-consumption of pulverisers. A separate chapter is devoted to costs of installation and operation of plants of various types in America. The report contains results of numerous tests which indicate that the process is well suited for the efficient utilisation of lignites, a matter of great importance to the central provinces of Canada.

H. HOLLINGS.

GASOLINE AND OTHER MOTOR FUELS. By CARLETON ELLIS and J. V. MEIGS. Pp. xix. + 709. (New York: D. van Nostrand Co.; London: Constable and Co., Ltd. 1921). Price 60s. net.

The subject of fuels for automobile engines becomes daily of greater importance owing to the converging tendency of the production curves for engines and fuels. This book thus appears at an opportune moment, and as it covers the whole of the subject in a very comprehensive way it will prove of great service to the many petroleum technologists who, by the development of "cracking" or other processes, are straining every nerve to increase the world's motor-spirit production. The authors state that they "have endeavoured to bring together such material as would constitute a substantially complete survey of the field." In this they have certainly succeeded. The book contains a mass of detailed information, is profusely illustrated, and has very copious references to the original literature. Such a mass of material as is here presented requires very careful digestion, a task which has been rather neglected, but perhaps wisely so, by the authors.

Arising out of this are the principal defects of the book. There is included much information (e.g., the description of distilling oils down to asphalt, and the process of "blowing" asphalt) which is quite beyond the scope of the title. One hundred pages are devoted to an appendix, giving a mass of statistics regarding the production and consumption of petroleum products generally. Many of the diagrams are of a very simple nature and might have been omitted without impairing the efficiency of the book. The description in detail of so large a number of processes, which have appeared only in the form of patent specifications, involves much overlapping and reiteration. The constant occurrence of the words "is said," and the frequent appearance of such phrases as "seek to obtain," "proposed by," lead the reader to think that the record consists largely of propositions, not accomplishments. Still, such a record has its uses, and may save many a technologist from wading through dreary files of patent specifications. In such a compilation it is only natural to find opinions expressed which are of no value and which have no foundation in fact, e.g., "that much of the gasoline now on the market contains heavy components which become separated from the lighter and more volatile hydrocarbons and settle out at the bottom of the automobile tanks." How refinery work might be simplified if that were the case!

A chapter is devoted to the testing of motor spirits including a description of the method and plant used for carrying out a bench-test with an engine. It is unfortunate that the book was published too early to allow of the inclusion therein of the very important work of Ricardo on the behaviour of various types of motor fuels in a variable-compression engine, recently published in the *Automobile Engineer* (Feb.-July, 1921). The chapters on benzol and alcohol as motor-fuels, which are useful additions, will also require some modification in view of Ricardo's work.

Four chapters are devoted to the method of distilling and refining gasoline in general use. The subjects of "cracking" and hydrogenation are very fully dealt with, no fewer than fifteen chapters being devoted to this subject. This is, perhaps, the outstanding feature of the book. The subject of the condensation of hydrocarbons from natural gas is fully dealt with, both in the text and in the appendix. This is an interesting development of the gasoline industry to which too little attention is usually paid in most books on the subject, so that its inclusion is a useful feature. Chapters dealing with the manufacture of benzol from coal, and that of motor fuel from shale-oil and from the products of distillation of asphalt complete the survey of the subject. The book is printed on highly glazed paper, and is very heavy for its size.

The writers are to be congratulated on the completion of what must have been a very laborious task, and doubtless many investigators will owe them a debt of gratitude for having collected and published such a record of work done on this subject of ever-increasing importance. It has been edited with great care, misprints and mistakes being conspicuous by their absence.

J. KEWLEY.

OBITUARY.

PROF. A. D. WALLER.

Prof. Augustus Désiré Waller, Director of the Physiological Laboratory of the University of London, who died on March 11, at the age of 65, was a man of broad outlook and exceptional energy. After more than twenty years' tenure of lectureships in physiology, he secured the necessary funds and rooms to establish an unique laboratory in the University Buildings at South Kensington. Here he broke with tradition; instituting carefully planned short courses of original lectures, without fee, on most varied topics, and providing facilities for research, again without payment, not merely in "pure" physiology but also in "applied" physiology and cognate subjects.

Waller's bias, in research, was physical rather than chemical. His personal contributions to science, which were numerous and of exceptional value, lay chiefly in the province of electrophysiology. His best-known work, the discovery that electrical disturbances accompanying the heart-beat could be detected and recorded on man, led, on the introduction of Einthoven's galvanometer, to the application of electro-cardiography in the service of medicine.

Waller's merits were recognised, none too lavishly, by the conferment of honorary degrees (LL.D. Edin., M.D. Geneva, D.Sc. Perth, W.A.), in the award of prizes by the Academies of Science of Paris and of Bologna, and in his election to the fellowship of the Royal Society.

His laboratory, which owes its unique character and scope to Waller himself, might well have been called a laboratory of physiological industries. Physicians, surgeons, veterinarians, anaesthetists, pathologists, chemists, toxicologists, botanists—all these, and others, found in it opportunity and facilities for prosecuting research and improving technique.

Waller served the University of London as Professor of Physiology, and, formerly, as Dean of the Faculty of Science and as Senator, displaying qualities which led to frequent invitations to represent the University at various University functions. His qualities, indeed, were recognised in many

quarters—both rightly and freely—in the utilisation of his services. In the matter of recompense, however, his recognition was scanty; few, who contributed so much, have received so little reward.

W. L. SYMES.

PUBLICATIONS RECEIVED.

A DICTIONARY OF APPLIED CHEMISTRY. VOL. III. EXPLOSIVES—K. By SIR E. THORPE, assisted by eminent contributors. Revised and enlarged edition. Pp. 735. (London: Longmans, Green and Co. 1922.) Price 60s.

BASIC SLAGS AND ROCK PHOSPHATES. By DR. G. S. ROBERTSON, with a preface by DR. E. J. RUSSELL. Pp. 120. Cambridge Agricultural Monographs. (London: Cambridge University Press. 1922.) Price 14s.

SCIENCE IN THE SERVICE OF MAN. ELECTRICITY. By S. G. STARLING. Pp. 245. (London: Longmans, Green and Co. 1922.) Price 10s. 6d.

THE VEGETABLE-OIL INDUSTRY IN THE BOMBAY PRESIDENCY. By A. F. YUILL. Department of Industries, Bombay Presidency. Bulletin No. 3. Pp. 95. (Poona: Superintendent, Government Printing. 1921.) Price, Rs. 1-13-0.

SUMMARY REPORT OF INVESTIGATIONS MADE BY THE MINES BRANCH DURING 1920. Mines Branch, Department of Mines, Canada. (Ottawa: F. A. Acland. 1922.)

THE FOREST PRODUCTS LABORATORY. A DECENNIAL RECORD. 1910-1920. Pp. 196. Published by the Decennial Committee, Forest Products Laboratory, Madison, Wisconsin, United States.

TREATMENT OF THE TUNGSTEN ORES OF BOULDER COUNTY, COLORADO. By J. P. BONARDI and J. C. WILLIAMS. United States Bureau of Mines. Department of the Interior. Bulletin 187. Pp. 79. (Washington: Government Printing Office. 1921.) Price 25 cents.

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. Department of the Interior. (Washington: Government Printing Office. 1921):—
BARYTES AND BARIUM PRODUCTS IN 1920. By G. W. STOSE.

STONE IN 1920. By G. F. LOUGHLIN and A. T. COONS.

SALT, BROMINE, AND CALCIUM CHLORIDE IN 1920. By R. W. STONE.

CORAL, MOLYBDENUM, NICKEL, TANTALUM, TITANIUM, TUNGSTEN, RADIUM, URANIUM, AND VANADIUM IN 1920. By F. L. HESS.

CEMENT IN 1920. By E. F. BURCHARD.

GOLD, SILVER, COPPER, LEAD AND ZINC IN NEVADA IN 1920. By V. C. HEIKES.

GOLD, SILVER, COPPER, LEAD AND ZINC IN MONTANA IN 1920. By C. N. GERRY.

GOLD, SILVER, COPPER, LEAD AND ZINC IN UTAH IN 1920. By V. C. HEIKES.

ZINC IN 1920. By C. E. SIEBENTHAL and A. STOLL.

MANGANESE AND MANGANIFEROUS ORES IN 1920. By H. A. C. JENISON.

GEMS AND PRECIOUS STONES IN 1920. By B. H. STODDARD.

CONCRETE STONE AND CONCRETE BLOCKS IN 1920. By R. W. STONE.

THE PASSING OF TWO GREAT SWISS CHEMISTS.

P. A. GUYE and T. SANDMEYER.

With the passing of Guye and Sandmeyer, Swiss chemistry has sustained two losses which are also the losses of science; for science is universal. Both were men of exceptional worth in scientific attainment and personality, and it is very difficult to realise that they are no more. The writer of these lines enjoyed the great privilege of intimate association with them—with Guye as an esteemed friend and colleague, with Sandmeyer as a technical collaborator for nearly eight years.

PHILLIPE A. GUYE.

Phillippe Guye was born in Saint-Christophe, Canton de Vaud, Switzerland, on June 12, 1862. He studied in Geneva and in Paris, graduating at both universities. After a long residence in the French capital, during which he worked under Friedel, Guye was called to the University of Geneva, where his output of scientific work was prodigious. His papers are so numerous that it is impossible to give an adequate account of them, even in outline; nearly 200 papers emanated from his laboratory, and the publications which bear his name number over 600 and cover more than 10,000 pages.

Following a number of researches in organic chemistry, Guye concentrated his energies on physical chemistry, a field in which he discovered new and fundamental relationships between the physical constants of fluids and their chemical constitution, especially with regard to the size of molecules; and concurrently with these extensive researches he developed his original and brilliant theory of the dissymmetry of molecules, which he supported with an almost incredible array of facts and other evidence.

From 1903 he turned to the field which he made particularly his own, viz., the determination of atomic weights. He was the author of over 100 papers relating to the atomic weights of nitrogen, chlorine, and bromine, and it is impossible to overrate the accuracy of his work, which is second to none in this fundamental branch of chemistry. The accuracy which Guye attained in this work, 1:10,000, has never been surpassed; and he obtained these marvellous results without the aid of costly apparatus, for the University of Geneva is not rich; his manual dexterity and his scientific *flair* overcame every difficulty. His researches on atomic weights represented a distinct advance on those of Marignac and Stas.

During all this time Guye never lost contact with the technical world. His investigations on the combination of nitrogen and oxygen under the influence of the electric arc gave rise to a number of fundamental patents, and his motive in doing this work was to enable Switzerland to produce all its requirements in nitrogenous fertilisers by developing its great water-power resources, amounting to 4 million h.p.

Having always regretted that Switzerland had no periodical chemical literature of its own, Guye founded his *Journal de Chimie Physique*, and he took a very active part in founding the *Helvetica Chimica Acta*.

Honours poured upon him. He presided in turn over practically every chemical society in Switzerland, and was a member of the International Committee on Atomic Weights. France made him a Chevalier de la Légion d'Honneur, and gave him the Prix Vaillant. The Royal Society, in addition

to awarding him the Davy Medal, made him an honorary member; and a similar honour was bestowed upon him by the chemical societies of Madrid, London, Petrograd, and Bucharest.

To the writer all the honours and success which fell to Guye's lot were of little significance in comparison with his personality. He was a most sincere friend, a most conscientious teacher and investigator, and a brilliant lecturer. His tact was recognised in every quarter, and although for him science had no frontiers, his sympathies were decidedly with France; Guye, with his magnificent sympathy, was the true link between the belligerent nations. His early death is sincerely regretted, not on account of unfinished work—work is never finished—but because men of his stamp, personality and world-wide reputation are rare and irreplaceable.

T. SANDMEYER.

In many respects Traugott Sandmeyer and Phillippe Guye represented two very distinct types. Sandmeyer was scarcely known outside the small circle of his collaborators and colleagues, he disliked publicity in every form, and although his life was devoid of startling adventures and great worldly successes, nevertheless, it was not without romance. His method of investigation and his manner of working differed so much from those of other chemists that everyone who came in contact with Sandmeyer felt that his personality was not an ordinary one and that he was capable of doing things which only genius can achieve. For this reason and because his ideas were inimitable and brilliant, he had no enemies, and even envy passed him by. The clue to all his successes was his extraordinary faculty of observation; he could detect the slightest deviation in a reaction and his discovery of a new method for synthesising indigotin was the result of this exceptional power, together with the gift of chemical divination. As a colleague he was always ready to help and advise, never expecting or desiring thanks. Most of the apparatus he used was of his own construction, for he was an expert mechanic. During the construction of the great dye-house in the Basle factory in 1916, he communicated to the architect his "feeling" that the reinforcement of the concrete was not one-third of the strength required, and on investigation it was found that a mistake had been made which would certainly have caused the five-story building to collapse. Owing to his conscientious method of work, to be his assistant was no easy task, not because he was an exacting master, but because he would perform every experiment himself; in fact, he had only one assistant, namely, himself, and a reaction which he had not seen did not exist for him. The discovery that 1,2,4-aminonaphthol-sulphonic acid can be diazotised, contrary to the statement of Otto N. Witt, was made because Sandmeyer tried not only naphthol as a coupling agent but also resorcinol, which couples much more readily with the minute quantity of diazo-compound that is formed, in spite of Witt's assertion. His discovery of the "Sandmeyer reaction" is another example of his power of observation, and there are many others. Entering the Geigy factory in 1888, he brought with him the constitution of Primuline, discovered by Green, and he told the writer that it took him but a few hours to find out (by distillation with zinc) that Primuline is related to thio-toluidine. But before 1888 Sandmeyer was already well known to organic chemists for his discovery of

the "Sandmeyer reaction" and the dangerous esters of hypochloric acid, and he was also the discoverer of thiophene.*

† The first result of Sandmeyer's studies in Basle was the discovery of diamidophenyltolyl, which enabled the Geigys to imitate all the Benzidine colours with the homologue. In 1889 he prepared Chrome Violet by condensing salicylic acid with formaldehyde and oxidising with nitrous acid, a reaction which was of great technical importance as it gave rise in later years to the beautiful series of the Azurols and the Aurins of the Malachite-Green series. In the same year he discovered his remarkable process for making Auramine (from tetramethyldiamidodiphenylmethane, sulphur, ammonium chloride and ammonia), carrying out the reaction in a kettle of his own construction. The year 1890 saw the discovery of the important method for producing dyes of the triphenylmethane

Setopaline, Setocyanine, Erioglaurine Supra, and a number of intermediates which were more of scientific interest. Sandmeyer was the first to discover that a sulphonic group in the *ortho*-position to the carbinol-group in the triphenylmethane-dyes gives rise to the Patent Blues, and that the methyl-group has a similar action.

The years 1887–1899 yielded new and highly interesting results of a scientific character. He made the *p*-aminobenzaldehydes by the action of hydroxylamine-derivatives on formaldehyde-derivatives and amines; and *p*-dimethylaminobenzaldehydes, which play an important part in the diagnosis of syphilis were prepared in almost unlimited number. He also made a number of aldehydes (e.g., vanillin, naphthaldehyde) by a modification of the Tiemann-Reimer method, and these compounds proved to be important in the manufacture of colours of the Naphthalene-Green type.



From a photograph by
PROF. H. E. FIERZ.

T. Sandmeyer.

class (starting from the hydrol) which is now in very general use in dye-manufacture (Acid Violet 5B, 6B). The following year he made the disulphonic acid of amidophenol (2.6.4) by the action of bisulphite on *p*-nitrosodiethylaniline, and found that formanilide when reduced with zinc-dust yields pure monomethylaniline, which at that time was needed in the manufacture of antipyrine. His achievements in the field of triphenylmethane-dyes were particularly numerous in the succeeding years; he made Helvetia Blue, Erioglaurine,

The year 1899 saw Sandmeyer's most remarkable achievement, viz., the preparation of indigotin from thiocarbanilide by a method which, although used only for a short time, appears to be one of the most brilliant in technical organic chemistry. In 1904 Sandmeyer showed how to diazotise the 1.2.4-amid-naphtholsulphonic acids from which were obtained Erio Chrome Blueblack B and R, Chrome Black T and A, and Erio Chrome Red B. Later, he prepared Erio Chrome Azurol and similar dyes by the reaction he had used in discovering Chrome Violet. During the war he took a very active part in the manufacture of the naphthalene-derivatives which the Basle manufacturers had previously bought from Germany. His last achievement was the finding of a new and very important method for manufacturing isatins, starting from amines, chloral and hydroxylamines, a method which gives quantitative yields and whose discovery showed that Sandmeyer was still the master of the subject.

On his retirement in 1919, Sandmeyer gave a large portion of his wealth to the pension fund of the firm for which he had worked during 31 years,

* Sandmeyer, whose veracity is beyond any doubt, told the writer the story of this discovery, which differs slightly from the version generally accepted. Victor Meyer wanted to show to his students the well-known isatin reaction of benzene with concentrated sulphuric acid. The benzene had just been prepared, during the lecture, from benzoate, but the red colour did not appear. Meyer got impatient, so Sandmeyer gave him a drop of benzene from a bottle on the shelf, the substitution passing unnoticed by Meyer. After the lecture Sandmeyer told Victor Meyer that there must be "something" in technical benzene, but Meyer had forgotten the incident entirely. It was only then that the case was investigated.

† The succeeding three paragraphs are based on notes supplied by Dr. H. Itzenbach.

and he retired to Zollikon, near Zürich. After a short illness, which was followed by an operation, he passed away early in April, in his 68th year.

The following additional facts were written by Sandmeyer a few weeks before he died.

Sandmeyer was born in Wettingen (Aargau) in 1851, on the day before the death of his father, who was a teacher of natural science and agriculture. Owing to this calamity, his mother had to resume her former occupation of school teacher, at Aarau, where Traugott attended the communal school. Stimulated by reading scientific books from his father's library, he developed a great interest in physical apparatus and manual work, so that instead of proceeding to the cantonal school he entered an engineering workshop.

Three years later he obtained employment in the mechanical and optical shop of J. F. Meier, of Zürich, but his health failed, and his mother having come to live in Zürich, he started a workshop in his own home and supplied apparatus to the chemical departments of the Federal Polytechnic. In this way he was brought into contact with the professorial staff, and in 1882 he became lecture-assistant to Victor Meyer, and soon started investigations which were published subsequently in the *Berichte*. In 1885 he accompanied Victor Meyer to Göttingen for one semester, and then returned to Zürich, where he served for three years under Hantzsch. In 1888, after three offers from dye-manufacturers, he joined the firm of J. R. Geigy, thus realising his secret wish to enter a technical branch of chemistry. In 1892 he married his step-niece Mina Billeter, of Männedorf.

In recognition of his work, the University of Heidelberg conferred upon him, in 1891, the degree of Phil. Doc., *honoris causa*. Ten years later he was appointed a director of J. R. Geigy and Co., which was then converted into a limited liability company; and when the firm celebrated its 150th anniversary in 1915, he was made an honorary doctor of the Technical "Hochschule," Zurich.

* * *

The lives of Guye and Sandmeyer appear to have little in common; but those who knew them intimately cannot accept this view. Guye and Sandmeyer represent the type of scientific men, like Bayer, Bunsen and Emil Fischer, which pursues science for its own sake. These great men never played any part in so-called society; and as we look around us we can but regret the disappearance of this school. Bon and Isler, too, have gone; colour chemistry seems to be at the end of its wisdom.

Sandmeyer and Guye were very different from many industrial chemists of the present time, and the idea that money comes before science could never have entered their heads. What would they have thought of so-called chemists who live by imitating their competitors and who even boast of appropriating the ideas of others? The young generation which has not seen a really great chemist at work overlooks only too readily the fundamental difference between knowledge which has been gained through original research and knowledge which has been learned from books and other second-hand sources. Every one of the truths which have been brought to light by these great and modest men entailed long years of hard, self-denying work. They represented the new ideas; they were the incarnation of science. Have the younger men the genius and the sense of modesty which alone bring lasting success? Have they the necessary power of persistent effort? This question seems the most important outcome of the lives of these two men. Their work was truly remarkable, but the example they have set overshadows even the greatness of their achievements.

H. E. FIERZ.

ACETYLENE IN TECHNICAL CHEMICAL SYNTHESSES.

The reactivity of acetylene renders it very useful in many chemical syntheses, and production at a low price is the only consideration determining the practical use of this gas in many well-known reactions. Such products as acetic acid, ethyl alcohol, acetal, aldol, and chlorine-containing solvents can be manufactured by reactions easily adaptable to large-scale operations, and the newer synthetical methods will come to the fore, in competition with older processes, so soon as the initial raw material, calcium carbide, is available at low cost.

The manufacture of calcium carbide involves the expenditure of over 4000 kw.-hr. of electrical power per ton of carbide, and if this power is available at, say, 0.1d. per unit, carbide will be manufactured at a cost of £5 per ton (*cf.* Report of the Nitrogen Products Committee, 1919). With power at about 0.33d. per unit, carbide could be produced at less than £10 per ton. Thus, countries possessing large water-power resources should be in an excellent position to manufacture cheap carbide, and, indeed, before the war, Norway generated power at 0.07d. per unit.

Many reactions which to-day are merely laboratory methods of preparation have been thoroughly investigated in large-scale apparatus and only await cheap acetylene for competitive manufacture to be commenced.

No attempt at collective recording of the possibilities of acetylene in industry has been made, so far as the writer is aware, except a flow-sheet published by Deschiens (*Chim. et Ind.*, 1921, 239). It is, therefore, proposed in this article to discuss the methods available for producing acetaldehyde, acetic acid, hydrogen cyanide, and condensation products such as pyridine, pyrrole, thiophene, but detailed estimates of costs of production cannot be considered owing to limitations of space. It should, however, become apparent that many of the methods to be considered are quite capable of technical realisation, and the costs of actual operation being relatively small, all that is required for economic success is cheap calcium carbide. To quote but a single example in advance, there seems every possibility that ethyl alcohol could be produced synthetically at about 1s. 6d. per gallon, provided calcium carbide is obtainable at £6 per ton, a likely figure in localities where cheap hydro-electric power, coal and limestone are available.

Acetaldehyde and Acetic Acid.

The manufacture of acetaldehyde from acetylene by catalytic hydration in the presence of mercuric salts as catalysts, and the oxidation of the aldehyde to acetic acid, have been described previously by the writer (*cf.* *J.*, 1921, 345 R). That the processes involved are capable of practical application is shown by the results of the operations of the Canadian Electro Products Co., of Meister, Lucius and Brüning, of the British Cellulose Co., and others. The commercial success of the process for manufacturing synthetic acid depends essentially upon the cost of calcium-carbide production, and when this cost becomes sufficiently low, it will be possible to manufacture economically many derivatives of acetic acid and acetylene. Thus, acetone can be produced by passing acetic acid over dehydrating catalysts at about 400° C., and the following long range of products may all be regarded as derivatives of acetylene: the acetates, acetyl chloride and anhydride, ethylidene diacetate, acetyl derivatives of organic acids, *e.g.*, acetylsalicylic acid, and

chloro-acetic acid for the manufacture of indigo. Again, acetaldehyde may give rise to aldol, butadiene, and hence synthetic rubber, paraldehyde, acetal, ethyl acetate (by catalysis) chloro-derivatives, etc., and the reduction of the aldehyde to alcohol presents one of the most attractive possibilities.

Ethyl Alcohol from Acetylene.

There are two distinct methods available, and of proved practical application, for obtaining alcohol from acetylene, both of which depend for their commercial realisation upon the availability of cheap acetylene.

For the production of large quantities of "power" alcohol, to replace petrol—the supplies of which are said to be within measurable distance of exhaustion—numerous processes have been suggested, all of which, however, depend upon the process of fermenting a starch- or sugar-containing material, and many of which involve the destruction of potential foodstuffs. Wherever the utilisation of waste cellulosic material, such as wood waste, is involved, the problems of transport, collection, locality of works, distribution of products, etc. present formidable obstacles. Moreover, the best results obtained have been yields of only 20–25 gallons of spirit per ton of waste wood treated. Fermentation of waste molasses, and waste sugar-products, of such materials as the Indian mahua flowers, etc., would provide insufficient alcohol to be of use in replacing petrol.

Finally, the vast reserves of tropical cellulose—reproduced annually—provide a very attractive source of "power" alcohol, if saccharification could be effected by bacterial action, or in any suitable manner. Such solutions of the problem of replacing petrol in internal-combustion engines, as have been advocated in America by Hibbert, Boyd, Whitford, and others, depend upon the discovery of economic methods of saccharification and fermentation. No satisfactory general method has, however, yet been found. On the other hand, two methods of manufacturing alcohol by synthesis are proved, and in case of need can be applied on any scale desired.

Hydrogenation of Acetaldehyde.

Sabatier and Senderens demonstrated the conversion of acetaldehyde into alcohol by passing its vapours, mixed with excess of hydrogen, over reduced nickel or copper. The temperature was set between the condensation point of alcohol and the point at which aldehyde began to decompose into carbon monoxide and methane.

This reaction has been used on a commercial scale by the Elektrizitätswerk Lonza, in Switzerland, which uses a large excess of hydrogen to remove the heat of reaction. A small quantity of oxygen—0.3 per cent.—is added to the hydrogen to prevent the formation of ether. The catalyst employed is reduced nickel and the temperature 150° C. (Swiss Patent, No. 74,129 of 1916; English Patent, No. 131,521). It has, however, been reported that financial success has not been established.

It is interesting to note that there are several installations for producing synthetic alcohol in Germany. In the first quarter of 1921 the Badische Co. produced 1000 hectolitres (22,000 galls.) of alcohol from acetylene at Ludwigshafen in a plant stated to have a capacity of 20,000 hl. per annum. At Burghausen, Upper Bavaria, there is a plant capable of producing 10,000 hl. of alcohol per annum.

The manufacture of alcohol in the above manner is dependent—for commercial realisation—upon cheap calcium carbide. Assuming yields of 80, 90 and 90 per cent. in the reactions of acetylene

formation, hydration to aldehyde, and hydrogenation of the latter, respectively, about two tons of crude calcium carbide are required for producing one ton of alcohol. If carbide could be made at £8 per ton (the pre-war cost in Norway) the process would be debited with £16 per ton of alcohol, in respect of carbide. The over-all cost of the manufacture of acetaldehyde has been placed at 70s. per ton (*cf. J.*, 1921, 345 R), and the cost of the hydrogenation step, including the 20,000 cb. ft. of hydrogen approximately required, and produced electrolytically (Hale, *cf. J.*, 1921, 122 R) should not exceed £6 10s. The total cost of producing a ton of synthetic alcohol should not exceed, in the best circumstances, £26 per ton, or less than 2s. per gallon.

This process, therefore, affords the possibility of producing alcohol in case of need and in the absence of a cheaper method based upon the utilisation of cellulose on a world-wide scale.

Production from Ethylene.

The second method potentially available for producing "power" alcohol consists in converting ethylene, produced by hydrogenating acetylene, into ethylsulphuric acid, and then hydrolysing the latter. The practical application of this method has been successfully demonstrated by Bury and Ollander at the Skinningrove works where the ethylene is recovered from coke-oven gas.

The hydrogenation of acetylene to form ethylene in the presence of reduced nickel was described by Sabatier and Senderens, but in their experiments ethane was always produced in greater or less amount. It has, however, been shown recently that ethylene can be produced by the catalytic hydrogenation of acetylene with little formation of ethane (Ross, Culbertson and Parsons, *J. Ind. Eng. Chem.*, 1921, 775). On a large scale the reaction would require further study, but it seems clear that a method could be evolved. The subsequent steps of absorbing the ethylene in strong sulphuric acid and hydrolysing with recovery of sulphuric acid have been shown capable of economic application on a large scale. The fundamental reactions involved in the absorption of ethylene and formation of ethylsulphuric acid have been studied from many aspects by Plant and Sidgwick (*cf. J.*, 1921, 14 R). The factor determining future success will be the first cost of raw materials, calcium carbide and hydrogen. In any country where cheap electric power is available, it should be possible to produce alcohol from calcium carbide at a cost not exceeding about £25 per ton.

Electrolytic Reduction of Acetaldehyde.—Pascal (Eng. Pat. 140,115; *J.*, 1920, 385 A) has described a method of reducing acetaldehyde in 5–10 per cent. sulphuric acid in the cathode chamber of an electrolytic cell divided by a porous diaphragm. If a mercury salt be added to the acid electrolyte, acetylene gas, introduced into the electrolyte, may be converted into alcohol, the acetaldehyde formed being hydrogenated at the moment of formation. The process is not yet in practical use.

Solvents from Acetylene: Trichloro-ethylene.

As early as 1869 Berthelot and Jungfleisch showed that acetylene is absorbed by antimony pentachloride, forming the compound $C_2H_2 \cdot SbCl_5$, which could be isolated, and which on distillation gave antimony trichloride and sym. dichloro-ethylene. When an excess of the pentachloride was used, sym. tetrachloro-ethane resulted. The formation of the symmetrical tetrachloride has been studied recently by Igi (Kogyo-Kwagaku Zasshi, 1920, *cf. Chim. et Ind.*, abstract, 1921, 6, 346).

For the manufacture of the more valuable solvent, ethylene trichloride or "Tri," the original Berthelot method is not employed. The reaction

between alcoholic potash and tetrachloro-ethane is not quantitative, and dangerous by-products are formed, but an excellent yield is obtained if milk of lime be employed. Thus a mixture of 100 parts of tetrachloro-ethane, 60 parts calcium hydrate, and 50 parts water, will give an 84 per cent. yield of trichloro-ethylene.

An interesting process of removing halogen hydride from tetrachloro-ethane is due to Tomkins. The tetrachloride is passed over porous materials contained in an acid-resisting tube which is heated to redness; hydrogen chloride is eliminated and trichloro-ethylene distils off. The chlorides of the alkaline earths or of heavy metals were employed later as catalysts, and the lower temperatures required permitted higher yields of trichloro-ethylene, decomposition into carbon and undesirable by-products being diminished.

The value of trichloro-ethylene as a solvent for fats, resins, general organic products, etc. requires little description; although its toxic properties, and its tendency to lose hydrogen chloride—which corrodes iron apparatus—are serious obstacles to its general use in industry, it is an excellent solvent and is non-inflammable.

Chloro-acetic Acid from Trichloro-ethylene.

According to the English patent of Simon and Chavanne (No. 129,301), trichloro-ethylene is hydrated by means of strong sulphuric acid (95 per cent.) at 150°–200° C., intimate contact between the reactants being effected by passing them down a heated tube packed with inert material. The hydrogen chloride produced is recovered and the mixture of chloro-acetic and sulphuric acids is separated by fractionation.

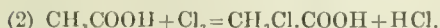
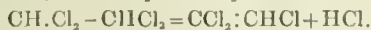
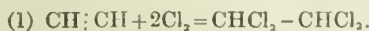
A more economical continuous process has been suggested, in which the trichloro-ethylene is added continuously to strong sulphuric acid, the necessary amount of water for the reaction



being added continuously. The acid is maintained at 160°–190° C. and the concentration kept above 90 per cent. The products passing from the reaction vessels are hydrogen chloride, unconverted trichloro-ethylene, and chloro-acetic acid. These are separated in a series of washing-towers and condensation systems, the hydrogen chloride is recovered, and the trichloro-ethylene and aqueous chloro-acetic acid are sent back to the hydration vessel, thus maintaining the required concentration of water therein.

The technical production of the above chloro-derivatives is dependent upon the provision of cheap calcium carbide as starting material.

Consideration of the rival merits of the two indicated processes for chloro-acetic acid production



must be deferred, but it may be noted that whereas in the first process more chlorine is used, in the second the two delicate stages of the hydration of acetylene and the oxidation of acetaldehyde are eliminated.

In the first process four chlorine atoms are required and two molecules of hydrogen chloride can be recovered, only one atom of chlorine being technically lost in the calcium chloride formed in the conversion of tetrachloro-ethane into trichloro-ethylene. In the direct chlorination of acetic acid, a molecule of chlorine is entirely utilised, either in forming the chloro-derivative or hydrochloric acid.

Condensation Products with Water, Hydrogen Sulphide and Ammonia.

It has long been known that under the influence of heat acetylene condenses to form benzene, styrol, naphthalene, retene, etc. Condensation products with water, hydrogen sulphide and ammonia are also known, and efforts are now being made to effect such condensations in specific directions by the aid of catalysts. Acetaldehyde, acetic acid, pyridine, pyrrole, thiophene, etc. have been produced, and the possibility of manufacturing many products of great technical value has been demonstrated.

The use of specific catalysts has been patented by the Chemische Fabrik Rhenania (Eng. Pat. No. 109,983), which uses metallic compounds containing water of hydration (retained at the temperature of condensation) and reducible by acetylene, e.g., bog-iron ore, bauxite, and complex hydrated silicates. Complete reduction to metal is inadvisable, except in certain cases of condensation with hydrogen sulphide, as carbon and high-boiling condensation-products are obtained.

If acetylene and water, in the proportion of 1:4, be passed over bog-iron ore at 400°–420° C., a yield of 15–16 per cent. of acetaldehyde is obtained; whilst acetone, higher aldehydes, acetic acid, etc. are produced, and the unchanged acetylene can be re-used. With an equal volume of steam, higher-boiling products are obtained, including phenol, tars, etc. The process will probably not compete with the ordinary methods of hydrating acetylene, referred to above.

When equal volumes of acetylene and ammonia are passed over bauxite at 350° C. fifty per cent. of the acetylene used is converted into acetonitrile, and pyridine, picoline, pyrrole, etc. are also produced. The importance of the state of hydration of the catalyst is emphasised in this reaction, for, with reduced catalysts, splitting of the acetylene molecule occurs with production of hydrocyanic acid and ammonium cyanide.

By passing a mixture of equal volumes of acetylene and sulphuretted hydrogen over a reduced metal catalyst at 300° C., thiophene, ethylthiophene, mercaptan, etc. are the resulting products. When the same mixture is passed over bauxite, which has been partly reduced in hydrogen at 480° C., thiophene is the principal product of condensation.

In each case the catalyst can be regenerated by oxidation in air at a high temperature and in presence of steam, so that the resultant catalyst may still possess water of hydration.

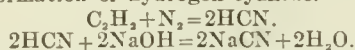
The above reactions are indicative of the possibilities awaiting further research.

Hydrogen Cyanide.

Berthelot showed that acetylene and nitrogen unite under the influence of an electric spark to form hydrogen cyanide (Comptes rend., 1868, 1141), after he had previously shown that acetylene is formed in a similar way from carbon and hydrogen, and that many hydrocarbons decompose at the temperatures of the electric arc to form acetylene. These experiments have formed the basis of many attempts, hitherto unsuccessful, to produce hydrogen cyanide on a technical scale. These attempts cannot be detailed here, but reference may be made to the study of the equilibrium between nitrogen, hydrogen, carbon, and hydrogen cyanide at various temperatures carried out by Wartenberg (Z. anorg. Chem., 1907, 299). Wallis also demonstrated that a maximum of 33.5 per cent. of hydrogen cyanide was produced from equal volumes of the reacting gases in the electric arc at 3250° C. (Ann., 1906, 353).

If, therefore, a catalytic process could be evolved to use cheap acetylene and nitrogen, and if large

conversions were obtained in a single passage, the success of this method of nitrogen fixation would be assured. The following equations show that a ton of calcium carbide and a ton of caustic soda would suffice for the manufacture of a ton of sodium cyanide, assuming only a yield of 80 per cent. of acetylene from carbide, and a loss of 20 per cent. in the formation of hydrogen cyanide.



Even with to-day's prices for the raw materials, this would offer a better financial return than any present method of producing cyanide.

INDIAN OTTO OF ROSE.

An interesting article in the February issue of the *Journal of Indian Industries and Labour* gives an account of experiments conducted at the Government Technical Laboratory at Cawnpore on the production of otto of rose. The authors are S. T. Gadre, Industrial Chemist to the Government of the United Provinces, and B. C. Mukerji, chief chemist, Office of the Metallurgical Inspector, Jamshedpur.

An investigation into the rose industry of the United Provinces was instituted two years ago by the local Government, and during two previous years experiments were conducted by the Indian Essential Oils Co., of Cawnpore. In its first report the firm recorded a yield of 0.0045 per cent. from flowers in the Aligarh district, and the second report announced that a yield of 0.025 per cent. had been obtained by improved methods of distillation. The prospect of the Indian rose industry appeared, therefore, quite hopeful, and fuller experiments were undertaken.

The flowers used for distillation were those of *Rosa damascena*, the species employed in Bulgaria, and were of the red or pink variety exclusively, which is the commonest Indian garden rose. The flowers from Hathras were packed in tins with common salt and sent by rail to Cawnpore; they were distilled by the Indian Essential Oils Co., and the distillates were forwarded to the Government Technical Laboratory at Cawnpore for examination. The flowers grown around Cawnpore were distilled at the Government Technical Laboratory in a steam still and a direct-fired still which was a modernised improvement of the Deg still. The flowers were collected early in the morning and distilled as soon as possible after collection. Distillation usually occupied from 3 to 5 hours and the weight of distillate collected was the same as the weight of flowers used. Double and triple distillations were also tried, the once distilled and double-distilled waters being mixed with more flowers and distilled from a copper still. In preparing these a layer of paraffin oil was placed in the receiver to minimise the escape of essential oil owing to the prevailing temperature and high winds. These layers of paraffin oil were afterwards collected and the amount of rose oil computed by determining the iodine-absorption figure of the paraffin oil. The oil content of the rose-water was similarly evaluated. Determined in this manner the average yield of otto obtained by distilling Cawnpore flowers amounted to 0.01 per cent. of the weight of the flowers.

It was found that the iodine-value determined by Wij's iodine solution gave satisfactory and concordant results. Calculations were based on 190 as the iodine-value for pure otto of rose, this figure being the mean values determined by Hudson-Cox and Simmons on various samples (Analyst, 1904, 29, 175) and agreeing with figures obtained by the authors for Bulgarian otto and a sample of pure otto made from Hathras roses.

The rose-water was evaluated by repeatedly shaking with chloroform and determining the amount of iodine absorbed by the chloroform extracts with Wij's solution, the time of interaction always being one hour, a period sufficient for complete absorption. Five successive extractions with chloroform were found completely to exhaust the rose-water of its oil. Once-distilled water made in the laboratory gave figures such as 0.0574, 0.0688, 0.0605, 0.0434 grams iodine absorbed by 450 c.c. rose-water, and thrice distilled water gave 0.2156 gm. Thus a classification of samples of rose-water can be made by the iodine-absorption method.

The paraffin oil used in the experiments was odourless, immiscible with water and only slightly volatile in steam. Any rose otto absorbed by paraffin oil can therefore be easily recovered in a practically pure state by distillation. The paraffin oil absorbed a variable amount of rose-oil, but the variation is only superficial since the absorption depends on the ratio of the volume of rose-water to the volume of the paraffin oil used, the distribution coefficient remaining constant. Thus 100 c.c. of paraffin oil absorbed more otto from 14 gallons than from 3 gallons of rose-water.

It was concluded from these investigations that rose flowers grown at various localities in the Aligarh District are superior for distillation to those available at Cawnpore or Ghazipur, the superiority being due to richer soil and better irrigation. By means of a preservative like common salt, the flowers can be stocked undamaged for three or four days after plucking. The high percentage yield of otto obtained by the Indian Essential Oils Co. could not be substantiated by the authors; the average calculated yield of otto did not exceed 0.015 per cent., and the optimum yield was found to be much lower than that usual in Bulgaria and elsewhere. Determination of the iodine-absorption of rose-water in the manner described was found to be a ready and reliable method of evaluating the rose-water.

The following types of stills were tried in the experiment:—The Deg type; the Bulgarian still; the steam-still in which steam is blown through the flowers; and an improved direct-fired still. All three stills gave practically the same results with a given variety of flowers. Live steam is unsuited for making otto from rose-flowers. A steam-jacketed still would be ideal, but its use may not be practicable on rose fields. The fourth type of still was a modification of the Deg still with a separate top, containing a fairly wide leading tube which could be connected with a worm condenser. It is portable and easily worked.

NEWS FROM THE SECTIONS.

CANADIAN PACIFIC.

On March 18 members of this Section, the British Columbia Chemists Club and the Students Chemistry Club of the University of British Columbia, joined in accepting an invitation to visit the new plants of the Triangle Chemical Co. and of the Acetate Products Ltd., recently established near the mouth of the Fraser River.

At New Westminster the Triangle Chemical Co. is manufacturing chamber, battery and concentrated sulphuric acid, as well as hydrochloric acid, superphosphate and a wide range of other fertilisers. Extensions to other lines of heavy chemical products are being planned. The visiting chemists greatly admired the excellence of design and process control in the plant and particularly

the safeguards to prevent broadcasting of objectionable fumes. The company has set a high standard for their fertilisers and other products, all of which are finding a large and growing market in Western Canada.

Mr. R. J. Walley, of Manchester, formerly superintendent of the James Island plant of the Canadian Explosives, Ltd., is superintendent of the new company, and associated with him are Mr. E. Legg, formerly superintendent, and Mr. M. H. Dobie, formerly sales manager of the Victoria Chemical Co.

Acetate Products, Ltd., at South Westminster, has recently put into operation its first unit for the destructive distillation of wood from the alder tree, which grows prolifically on the Pacific Coast, reaching a diameter of a foot or more. The plant is equipped with the most improved facilities and apparatus for the production or refining of charcoal, wood-tar oils, acetate of lime and methanol (wood alcohol). As this is the first complete wood-distillation plant to be established in Western America, an unlimited local and export market is found for the products.

Mr. Norman Ross has been chiefly interested in promoting the new industry, and Mr. P. A. Carleton has supervision of the design, construction and operation of the plant. For a number of years Mr. Carleton superintended the operation of hardwood-distillation plants in Eastern North America and since coming to British Columbia has consulted with Dr. H. K. Benson, professor of industrial chemistry, University of Washington, and director of the Seattle Station of the United States Forest Products Laboratory. Dr. Benson has specialised in the utilisation of the woods of the north-west Pacific Coast, and has carried out extensive chemical researches in this field of investigation.

After the excursion, members of the British Columbia Chemists' Club attended a dinner at the Vancouver Citizens' Club, following which a discussion was held on the subject of legislation for professional chemists and the advisability of forming a local section of the Canadian Institute of Chemistry.

MANCHESTER.

Prof. J. S. S. Brame read a paper on "The Possible Economic Development of Home Supplies of Fuel Oil" at the meeting held on April 7, Dr. E. Arden presiding.

After showing the necessity for considering possible developments of home supplies of fuel oil, Prof. Brame discussed the findings of the committee appointed by the Institution of Petroleum Technologists in 1918 to ascertain the quantity of cannel coal available in Great Britain as a source of fuel oil, etc. and to formulate a scheme for utilising such supplies. The committee concluded that it was economically possible to assemble at least 1200 tons per day of retortable material for treatment and that, assuming an average yield of 30 gallons of oil per ton, a production of 300,000 galls. of crude oil per day or over 400,000 t. per annum would be possible. Much of this oil, however, would require "cracking," or distillation to remove pitch, and its calorific value would be lowered by the high content of tar acids, which could not be separated economically.

Prof. Brame then considered the position of the Scottish shale-oil industry and mentioned the deposits of shale which outcropped in Dorset and Norfolk, but whose high sulphur content is extremely difficult to eliminate. Referring to the low-temperature carbonisation of coal he expressed the belief that the commercial unit for this process had been developed in more than one instance.

Taking the over-all efficiency of a direct-fired, steam-turbine plant as 100, the efficiency of low-temperature carbonisation was between 72 and 75 per cent., but if the coke was gasified and the gas used at 75 per cent. efficiency for raising steam, then the efficiency was only about 40 to 45 per cent.; further the ratio of coal consumption in the two processes would be 1.32—1.39:1, or if the coke was gasified 2.2—2.5:1.

Although there was probably little torbanite in this country, it contained material that was very rich in oil. Bastard cannels usually had a high ash content, but they could be retorted; most of the cannels would yield 40 and a few 50 gallons of oil per ton, but the worst would yield 20—30 galls. The question whether it would pay to retort poor cannels depended mainly on the utilisation of the gas obtainable from the carbonaceous residue, which contained the bulk of the nitrogen, so that a good revenue might be derived from gasification and recovery of ammonium sulphate.

Low-temperature tar could be described as intermediate between petroleum and high-temperature tar; it had a comparatively high content of saturated hydrocarbons, a small content of benzenoid hydrocarbons and a low content of carbon. It contained no naphthalene but a large quantity of tar acids, which could be washed out easily. Cannel oils differed from low-temperature oils; and coke from bituminous material differed from that obtained from cannel in containing paraffin wax. It was doubtful whether it would pay to extract the paraffin wax. Low-temperature oils sometimes held water very persistently which in some cases appeared to be in a perfect state of solution.

AMERICA.

On April 21 a joint meeting of the Section with the American Chemical Society, the American Electrochemical Society and the Société de Chimie Industrielle was held in the Rumford Hall of the Chemists' Club, about 250 members and guests attending.

The business of the meeting consisted in the election of the officers and members of the Executive Committee as follows:—

Chairman, Ralph H. McKee; hon. sec., Allen Rogers; hon. treas., F. C. R. Hemingway; Executive Committee (new members), S. R. Church, J. Helfrich, E. R. Weidlein, B. T. Brooks, T. J. Keenan, R. Fitzgibbon, F. E. Breithut; (old members), T. R. Duggan, H. S. Miner, C. E. Sholes, H. G. Carrell, D. D. Jackson, W. H. Fulweiler, A. D. Little.

The programme of the evening consisted in the reading of the following papers:—

(1) "Modern Methods in Fatty-Acids and Glycerin Distillation": J. W. Bodman; (2) "The Chemistry of Oilcloth Manufacture": Randolph C. Farra; and (3) "The Valuation of Crude Glycerin and the 1922 Glycerin Committee": A. C. Langmuir.

BIRMINGHAM.

A joint meeting with the Institute of Brewing was held at the University of Birmingham on April 27. Prof. A. R. Ling presided, and Dr. E. J. Russell read a paper on "Barley: A Study in Modern Agricultural Chemistry."

The research scheme of the Institute of Brewing has made it possible to begin a close investigation of the relation between the malting quality of barley and agricultural conditions. Plots have been laid out on a number of good barley farms in good barley districts and treated with fertilisers

in accordance with a definite scheme. The resulting samples of barley will be investigated to ascertain: an empirical valuation; content of moisture and nitrogen; weight of 1000 grains; malting by the Blaber cupboard process; and composition of extract. It is hoped that the results obtained will throw light on the effect of fertilisers on the yield and quality of barley and on the influence of soil and season on malting quality. A distinct advance would be made if it could be proved that good malting quality is equivalent to favourable growth or maturation in the second part of the plant's life. Further studies are to be made of the effect of the variety of plant on malting quality, in order to find varieties most suitable both for farmer and maltster. The chemical characterisation of a good malting barley will also be investigated. For the final solution, advances in biochemistry must doubtless be awaited, but the work of Prof. Ling and others is gradually clearing away difficulties. The research scheme has led to co-operation among the farmer, the maltster, the malt and brewing chemist, and the expert in agricultural science, a result which alone would justify the scheme.

At the conclusion of the paper, Prof. Ling announced that he had practically completed an investigation on the estimation of starch in cereals and would soon be able to state the results.

LONDON.

On May 1, at Burlington House, W., Mr. E. V. Evans presiding, Dr. J. J. Fox and Mr. A. J. H. Gauge presented a paper on "The Determination of Tar Acids and Tar Bases in Drainage and Mud."

Experimental work on the effect of drainage from tarred roads upon fish has shown that such drainage is harmful, especially when the tar is wet and when the road-surface is breaking up under the action of weather and traffic. The dangerous constituents of the tar are phenols, naphthalene, and particularly acridine, which is very toxic in a concentration of 1 in 5 million parts of water, but less dangerous in the presence of minute amounts of phenol. Phenolic substances, which are widely distributed in plants, may be distinguished from tar phenols by Folin's reagent (phosphomolybdic acid), and the two classes may be separated by steam-distillation, the tar phenols volatilising. For the quantitative estimation of tar bases, the water or other material is extracted with chloroform and the extract treated with sodium-hydroxide solution, in which the phenols are soluble. This solution is diazotised in the presence of sulphanilic acid, when yellow or red colours are produced and the phenols present are estimated by comparison with standard solutions of phenols similarly treated. Tar bases may be estimated by shaking the chloroform-extract with sulphuric acid, and precipitating the bases with iodine solution containing potassium iodide. Alternative methods consist in measuring the depth to which fluorescence extends in the solution contained in a quartz cell illuminated by an arc-lamp, or in examining the characteristic absorption spectrum in the ultra-violet. Quinoline, iso-quinoline and acridine may also be estimated by precipitation as salts of picric acid. The presence of tar bases and tar phenols in water or mud shows undoubted contamination by road tar. Analyses of samples should be made promptly as most of the tar acids and bases disappear rapidly under the influence of dissolved oxygen and micro-organisms. Iso-quinoline and acridine are not attacked by organisms. The obvious remedy for avoiding fish fatality is to employ upon roads a tar not containing any deleterious constituents; but such a tar is at present unobtainable commercially.

A paper by Mr. A. J. H. Gauge entitled "The Disposal and Purification of Flax-retting Effluents" was read in his absence by Dr. J. J. Fox. These effluents are deep-yellow liquids of foul odour and somewhat resemble the waste liquors from distilleries, breweries and maltings. Very small amounts of solids are present and the rapid oxygen-absorption produced on running into a river causes the death of fish by asphyxiation. Such effluents may be treated with lime and alum, or other chemical agents, by means of which a large proportion of the organic matter is removed. A more satisfactory method is to pass the effluent slowly through a sand-filter which has been previously treated with an aqueous extract of turf containing nitrifying organisms. By this means 90 per cent. of the organic matter present is removed.

At the annual meeting, which preceded the reading of the papers, the following were elected to fill the vacancies on the committee caused by the retirement of Messrs. E. R. Bolton, A. H. Dewar, C. Dorée, C. A. Keane, and Prof. J. C. Philip:—Mr. W. Cullen, Dr. J. J. Fox, Dr. J. Reilly, Mr. H. M. Ridge, and Dr. C. S. Roy.

THE INSTITUTION OF CHEMICAL ENGINEERS.

The inaugural meeting and dinner of the Institution of Chemical Engineers were held at the Hotel Cecil, London, on May 2, under the chairmanship of Sir Arthur Duckham, who has been acting as chairman of the Provisional Committee appointed at the meeting held on November 9, 1921 (*cf.* J., 1921, 428 R). The Provisional Committee subsequently co-opted Dr. E. W. Smith, Mr. S. G. M. Ure and Mr. C. S. Garland.

In his report, Prof. J. W. Hinchley, hon. secretary, said that the Provisional Committee had decided that the Institution should take the form of a limited liability company, limited by guarantee, the word "limited" being omitted by permission of the Board of Trade. The Draft Memorandum, Articles of Association and By-laws had been approved after submission to all those who had taken an interest in the formation of the Institution—some 200 persons in all—as well as to a number of kindred institutions, such as the Institute of Chemistry, the Institutions of Civil, Mechanical, Electrical, and Gas Engineers, the Institution of Mining and Metallurgy and the Institution of Mining Engineers. Every effort was taken and would be taken to ensure amicable and cordial relations with the existing bodies. Mr. K. B. Quinan had attended the seventh meeting of the Committee. The final draft of the constitution was now in the hands of the Institution's solicitor, who had been instructed to take the necessary steps for registration. A Selection Committee consisting of Messrs. F. H. Rogers, E. W. Smith and J. W. Hinchley had been formed to deal with the question of membership, and it had been laid down that no members of any grade should be elected without the regular formality of application, selection and election by the Council. The objects of the Institution, as set out in the Memorandum and Articles of Association, were to encourage and help to create a new kind of professional man, the chemical engineer, and the Institution would devote all its energies to producing and maintaining a high standard of educational, technical and professional attainments.

Mr. F. H. Rogers, hon. treasurer, said that the guaranteed donations to date amounted to £1425,

and they were still coming in. The disbursements had been £433, and the actual cash received £606. Although they had sufficient funds in hand at the moment, the Committee was aiming at the sum of £3000, which should tide it over its initial stages. There might be opposition when the Institution came to apply for a Charter and funds would be necessary in that event. Therefore, he hoped everybody would assist financially the Institution to the fullest possible extent.

The chairman commented on the need of the industries of the country for chemical engineers, and said that the Institution would do extremely valuable work if it were fully supported. The one thing that would kill it was lethargy. America had gone ahead of us because she had given more consideration to chemical engineering than we had, and he appealed to all interested to give the fullest possible active support to the new Institution. At the same time, he said he still maintained the attitude that he had expressed at the November meeting, viz., that he was opposed to a multitude of institutions, and he hoped that this one would be the last and that there would be some form of amalgamation, at any rate as regards meetings, of the various institutions concerned. Overlapping between institutions was to be deprecated, and he hoped that the work of the Institution would lead to a union of institutions in some form. The new body must associate itself with existing institutions on the most amicable terms, and the last thing they wanted to do was to fight.

Mr. W. J. U. Woolcock, who has acted as vice-chairman of the Provisional Committee, explained some of the by-laws, and in particular those dealing with the conditions of membership, entrance fees, subscriptions, and examinations. There are to be members, associate members, graduates and students, the respective entrance fees being five guineas, three guineas, one guinea and half a guinea, and the subscriptions, five guineas, three guineas, two guineas, and 10s. 6d., students over 21 years of age paying one guinea. These subscriptions are for members residing in the United Kingdom.

Prof. J. W. Hinchley read a letter from Prof. F. G. Donnan, and said that he had many others of a similar nature. After expressing his disappointment at not being able to be present, Prof. Donnan said:—"There may be many difficulties ahead in connexion with this enterprise, but I feel sure that it has a great work to perform, and if properly supported will have a great future. In my opinion chemical engineering is one of the most important, if not the most important, department of science and practice in a modern civilised State. . . . With the exception of a small and select band of men, this subject has been largely neglected in the British Empire in the past. I feel sure that the foundation of the Institution of Chemical Engineers will go far to rectify this state of affairs. Both to engineers and chemists the subject of chemical engineering offers the fullest and widest scope for the application of science to an industry which will assuredly be the dominating factor in the civilisation of this century."

Sir Frederick Nathan moved the following resolution:—"That this meeting congratulates the Provisional Committee on having formed the Institution of Chemical Engineers on the lines indicated in the Memorandum and Articles of Association and By-laws, and believing that such Institution will be of the greatest utility, will do everything possible to forward its interests."

Dr. W. R. Ormandy seconded the resolution and urged that particular care should be taken to encourage the graduates and students of the Institu-

tion, because the prosperity of any institution depended very largely upon its younger members.

A short general discussion followed. Mr. F. H. Carr pleaded for an alteration in the curricula at our universities so that training for engineering and chemistry could proceed side by side. Mr. P. Parrish expressed pleasure at the high standard set for membership of the Institution. Dr. R. Seligman suggested that the subscriptions had, perhaps, been fixed too high. This opinion was opposed by Mr. E. A. Alliot, Mr. C. S. Garland, and the chairman, the last-named stating that there had been suggestions for reducing the subscriptions which had been decided upon, and also suggestions for increasing them; the latter were the more numerous, and it was felt that they had been fixed at a reasonable level.

Dr. B. T. Brooks, a member of the American Institute of Chemical Engineers, said that, although he was not authorised to speak officially on behalf of that body, yet he would not be presuming in welcoming the inauguration of the new Institution. Chemical engineers in America were now exerting a strong influence in many ways, particularly in the universities, where the professors of chemical engineering now ranked with the heads of other departments.

The Chairman said it was clear from the discussion that they could now go ahead. He wished to emphasise the point that the scope of the chemical engineer must be much wider than the manufacture of chemical commodities. Every industry wanted the chemical engineer, and the reason why chemists in the past had been frightened to come forward with suggestions in the works was because they had not had the engineering training to give them sufficient confidence.

Prof. Hinchley, in the final speech of the evening, said that the inspiration for the formation of the Institution really came from the late Lord Moulton, who had conceived the idea during the war, and he would like Lord Moulton's name to be associated with the Institution in some way. Many firms had written asking how they could become associated with the Institution. There was the method of giving donations and they would be delighted to acknowledge any donations in a public way, and he hoped the industry would support the Institution in that manner.

A further meeting will be held in the autumn.

MEETINGS OF OTHER SOCIETIES.

CANADIAN INSTITUTE OF MINING AND METALLURGY.

The annual meeting of this institution was held in Ottawa from March 1-4. The opening address of the president, Mr. C. V. Corless, general manager of the Mond Nickel Co., Coniston, Ontario, was devoted to the mineral resources of Canada, and particularly to the great possibilities of the Laurentian highlands which extend across Quebec and Northern Ontario and embrace the famous Lake Superior iron, Michigan copper, Sudbury nickel, Cobalt silver and Porcupine gold, mines. Passing to the westward he pointed to the important mineral developments of the Pas district in Manitoba and the established metalliferous mines of the west, including the Klondike, Atlin, Anyox, Britannia, Slocan, Rossland, Sullivan and Boundary. He referred to the fact that fully one-sixth of the coal reserves of the world is situated in Canada, and largely in the province of Alberta. The generally accepted view that Canada is pre-eminently an agricultural country was shown to be

fallacious, for its present greatest natural resources lie in its mineral wealth. This was more clearly illustrated in the next paper which was read by Charles Camself, Deputy Minister of Mines, Ottawa, upon "Minerals and our Railways." He showed that, according to official statistics, 35.4 per cent. of the total tonnage hauled by the railways is the direct product of the mine and if manufactured products be included the percentage is about 44.0. The nearest competitor, agriculture, only accounts for 17.2 per cent. of the tonnage. Comparative statistics were given for several other industries.

Mr. R. L. Peek, British American Nickel Corporation, Ottawa, spoke upon the recovery from Canadian ores of the metals of the platinum group (platinum, palladium and iridium) by the nickel industries. This is a matter of considerable importance to the refineries in Canada. André Doriman, Timmins, communicated a paper on "The Metallurgy of Carbonaceous Ores." In certain parts of Northern Ontario, gold is found associated with a considerable quantity of what is locally termed graphitic schist. This material gives the mining men considerable trouble as it precipitates the gold from the cyanide solutions with the result that gold is lost. Roasting the ore overcomes the difficulty but it is too expensive, but the loss is prevented by adding a mixture of fuel and gas-oils direct to the ores in the ball-mill and tube-mill scoops, to the extent about 2 gall. per ton of ore. This process does not involve the use of an increased amount of cyanide and is being worked successfully on a large scale.

Other papers read at the meeting were: "Economic Relation of Gold Production," Prof. A. Shortt; "Possibility of the Use of Seaplanes in Exploring Pre-Cambrian Areas," E. L. Bruce; "Felspar in Ottawa District," N. B. Davis; "Ontario Gold Deposits," Percy Hopkins; "Gold-Dredging in the Cariboo District, B.C.," W. A. Johnston; and several other technical contributions all of which will be published in the *Bulletin* of the Institute. The nickel works of the British America Nickel Corporation, at Deschenes, and the mine and smelter of the Kingdon Mining, Smelting and Manufacturing Co., at Galetta, 35 miles from Ottawa, were visited by the members of the Institute during the meeting.

SOCIETY OF DYERS AND COLOURISTS.

The annual meeting was held in the Midland Hotel, Manchester, on March 31, with Mr. H. Sutcliffe Smith in the chair. Mr. H. Sutcliffe Smith was re-elected president and the retiring vice-presidents, members of council, and other officers were also re-elected. It was announced that the medal of the Worshipful Company of Dyers for 1919-20 had been awarded to Dr. A. E. Everest, and that Mr. A. J. Hall would receive a diploma as co-author. The grant given by the Department of Scientific and Industrial Research has been withdrawn, as the Department has now to divert its funds largely to the big research associations.

At the annual dinner, held at the close of the meeting, Sir P. Lloyd-Greame, in proposing the toast of "The Society of Dyers and Colourists," reviewed the present economic situation and paid a tribute to the services that Mr. Sutcliffe Smith had rendered to industry. In replying, Mr. Sutcliffe Smith appealed to the big dye-making firms for donations to enable the Society to continue its research work, and said that it was hoped to issue the Colour Index in about twelve monthly parts, starting in June; the Index would contain at least 200 colours more than Schultz's "Farbstofftabellen," and obsolete colours would find no place in it.

SOCIETY OF GLASS TECHNOLOGY.

The fifth annual meeting of the Society was held on April 26 in the University of Sheffield. Dr. M. W. Travers, retiring president, announced that the Council had nominated Prof. W. E. S. Turner as his successor, and this nomination was agreed to unanimously. The other officers elected to fill vacancies were:—Vice-Presidents: W. Butler, C. J. Peddle, W. W. Warren; Ordinary members of Council: H. H. Asquith, W. Butterworth, J. H. Davidson, F. W. Hodkin, V. H. Stott; Treasurers: J. Connolly, W. M. Clark (U.S.A.); Secretary: F. G. Clark, and assistant-secretary, S. English.

In his presidential address, entitled "The British Glass Industry: Its Development and Outlook," Prof. Turner outlined some of the work he hoped the Council would be able to do during the forthcoming year, including the revision and re-issue of standard specifications for certain glass-furnace refractory materials. He hoped it would also be possible to formulate specifications for some of the more important glassmaking materials and to set up standard tests for glass itself.

Prof. Turner then gave a comprehensive account of the growth of the British glass industry from the time of the Roman occupation to the present day. Speaking generally, there was a steady growth up to the year 1875, when the number of glass factories began to decrease and the imports of finished glassware to increase. This steady decline was arrested on the outbreak of war in 1911, and during the last few months of 1911 and 1915 there was an infusion of new blood and the industry was revived. Under the stress of war certain new branches of the industry had to be created, the production of chemical glassware had to be undertaken, and the building-up of a lampworking industry begun. These new branches of the industry grew to such an extent that during the last twelve months of the war more than two million pieces of chemical glassware were made at the furnace, more than 39 million lamp-blown articles, and more than one million lb. of glass rod and tubing. During the same period the output of electric lamp-bulbs exceeded 13 millions, whereas in pre-war years it was not more than 4 millions.

The immediate outlook of the industry was not cheerful, but the industry was much more efficiently equipped than at any other time in its history, and provided that politicians could settle the problem of international exchanges before it was too late a prosperous future could be anticipated. There was plenty of scope for new developments in the industry, so that there was no need to lose confidence.

The Very Rev. Dr. W. Foxley Norris, Dean of York, gave an interesting address on the medieval glass of York Minster, in which he pointed out that the windows of York Minster were the finest examples of thirteenth and fourteenth century English stained glass. Unfortunately the glass was showing signs of decay, and in some cases the deterioration was very pronounced. The work of cleaning and re-leading the windows was proceeding, and various means of preserving the glass itself from further decay were being tried.

In the evening the annual dinner was held at the Royal Victoria Station Hotel, Sheffield, Prof. W. E. S. Turner presiding. The toast of "The Glass Industry" was proposed by Sir A. J. Hobson, who observed that the doctrine that restriction of output helped to create additional work was totally untrue. True wealth consisted in abundance and cheapness of production, and this was the way to the greatest comfort for everyone concerned. Col. S. C. Halse, of Messrs. J. Lumb and Co., Ltd., Castleford, replied to this toast. The other toasts were: "The Society of Glass Technology," proposed by the Dean of York, Prof. Turner replying, and "The Guests," proposed by the Lord Mayor of Sheffield and replied to by Dr. M. W. Travers.

SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting was held at the Chemical Society's Rooms on May 3, when Mr. P. A. Ellis Richards presided and four papers were read.

In a paper entitled "Studies in the Titration of Acids and Bases," Messrs. J. L. Lizius and N. Evers described the application of the newer indicators to ordinary titrations of acids and bases, and recommended new indicators and combinations of indicators which give sharper colour changes at the end-point and more accurate results than the indicators commonly used. Methods of determining the hydrogen-ion concentration of the true end-point of a titration were discussed and a table was given showing the hydrogen-ion concentration and sharpness of the end-point, the best indicator, and the accuracy of the results.

Mr. C. Ainsworth Mitchell gave further details of his microscopical method of examining graphites, and compared his results with the chemical composition of old and modern graphites and pencil pigments, including a graphite from Egypt (B.C. 1500). He also cited analyses of the pigments in typical coloured pencils and discussed how their markings on paper can be distinguished.

"The Inadequacy of the 'AR' Test for Alkalis in Calcium Carbonate" was discussed by Messrs. W. Singleton and H. Williams, who find that the test requires revision, as only about 10 per cent. of the total alkalis present in several samples of calcium carbonate of "AR" quality was removed by the single extraction with distilled water prescribed by the test. Five extractions removed only about 15 per cent. of the total alkalis and only one-half of this total was extracted in the first treatment.

Dr. J. C. Drummond presented a paper on "The Sulphuric-Acid Reaction for Liver Oils and its Significance." The chromogenic substance giving the characteristic colour-reaction appears to be a normal constituent of the liver, as the author has found it in the liver of man and 21 animals. It appears to be related to vitamin A, because the classification of cod-liver oils of known purity according to the intensity of their colour reactions, is found to be the same as that based upon content of the vitamin. The colour reaction is correspondingly feeble for oils obtained from animals deprived of vitamin A. Attempts to trace the origin of the chromogenic substance in the food of the cod have failed. The few known properties of the substance and the information available on its distribution suggest resemblances to the unidentified vitamin A, and without assuming the identity of the two factors, the author suggests that the association may be significant.

THE CHEMICAL SOCIETY.

At the meeting held on May 4, Prof. J. F. Thorpe presiding, Prof. E. C. C. Baly and Mr. H. M. Duncan presented a paper on "The Reactivity of Ammonia," in which they adduced evidence for the existence of a second form of ammonia, which is relatively inactive but which slowly reverts to the ordinary active form. Inactive ammonia is present in liquefied ammonia and is evolved when the latter evaporates.

Prof. Baly also summarised some highly interesting work, done in collaboration with Prof. Heilbron and Mr. D. P. Hudson, on "The Photosynthesis of Nitrogen Compounds from Nitrates and Carbon Dioxide." The reaction leading to the formation of "activated" formaldehyde takes precedence over all others; this formaldehyde, *inter alia*, reacts with nitrite to produce hydrocyanic acid, which can react with more aldehyde in three ways and yield ultimately amino-acids, substituted amino-acids, and alkaloids. The formation of these substances has

been proved, but they have not yet been isolated in a pure state; the reactions involved take place very rapidly and are difficult to control.

Other papers presented were: (1) "On Dopplertite: Studies in the Composition of Coal": F. V. Tidswell and R. V. Wheeler; (2) "Bromo-derivatives of Glyoxaline": I. E. Balaban and F. L. Pyman; (3) "The Properties of Ammonium Nitrate": E. P. Perman.

NEWS AND NOTES.

AUSTRALIA.

Resources of Papua.—Little has been published hitherto concerning the vast resources of the Commonwealth territory of Papua, and therefore the information supplied by the Commonwealth Statistician, in Census Bulletin No. 4, is especially welcome.

Papua possesses a wide range of timbers and over 120 species have already been recorded as suitable for exploitation and use; in 1920, 92,215 acres was being exploited under timber licenses and two saw-mills were operating. The minerals discovered include gold, silver, osmiridium, copper, tin, lead, zinc, cinnabar, iron, manganese, sulphur, graphite, gypsum, coal, and petroleum. Gold is widely distributed and the value of the output between 1900 and 1906 averaged over £80,000 per annum, but production has since declined. The Astrolabe copper field, situated on the south-west of the Astrolabe Range, covers an area of about 1000 sq. miles; only two mines, the Loloke and the Dubana, have been opened, and in 1918-19 they yielded 1100 tons and 231 t. of ore, respectively. Escapes of natural gas occur on the banks of the Vailala River, but so far prospecting for petroleum has not been successful. Extensive beds of poor, lignitic coal are found in the area between the Vailala and Kikori rivers, good samples of galena, silver-lead and zinc ore have been obtained in Woodlark Island, and small quantities of cinnabar have been discovered in four different localities. The deposits of graphite and osmiridium are of doubtful commercial value. Native labour is both adaptable and intelligent, but not very plentiful.—(*Ind. Austral.*, Feb. 9, 1922.)

BRITISH INDIA.

Proposed Sugar Factory in South Bihar.—Hitherto attempts to establish sugar factories in South Bihar have failed as all the land is owned by small cultivators. Tirhut, which has an area under cane equal to that in South Bihar, has succeeded in establishing 10 factories because the European planters there own sufficient land to grow sugarcane in rotation with indigo, and cane can always be purchased in a free market. If sugar manufacture on modern lines is to be introduced into South Bihar, the Government will have to pioneer the industry. Accordingly, it has been proposed, with the approval of the Bihar and Orissa Board of Industries, that the Government should erect a modern factory, capable of crushing 50 tons of cane a day, in a suitable centre in South Bihar, and it is hoped that funds will be available for this purpose in the coming year. With such a factory it would be possible to introduce and extend the free sale of cane by cultivators to central factories, and to decide whether the small plant decided upon, which is believed to represent the economic limit, could compete with larger plants. The factory would also provide a station in which Indians could be trained in the chemistry and engineering of sugar manufacture.—(*J. Ind. Indust.*, Feb., 1922.)

Research in Vegetable Oils and Fats.—As a first step in an industrial survey of the resources of the Central Provinces, the reconstituted Advisory Board of Industries has recommended the erection and equipment of a research and experimental laboratory at Akola for investigating vegetable oils and fats. The local government has approved the recommendation and sanctioned the inclusion of a sum of Rs. 75,000 in the departmental budget for 1922-23.—(*J. Ind. Indust., Feb., 1922.*)

CANADA.

Mining News.—Increased interest is being taken in copper-mining in British Columbia. The Iron Mask Mine, at Kamloops, and the Tide-water Copper Co., of New York, operating the Dewdney mine at Sydney Inlet, on the west coast of Vancouver Island, are resuming operations this spring.

Great developments have taken place since the discovery of silver in the Keno district of the Yukon, in 1919, and about 1500 mines are now being worked. The Alaska-Treadwell and Slate Creek Mining, two large American companies, entered the Mayo field in 1921, and the Yukon Gold Co. has also entered the district.

The Cedar Creek Gold Syndicate, of Vancouver, has disposed of its holdings on Cedar Creek to the Del Ecuador Mining Co., Ltd. A dredge will be in operation this spring, and the estimated amount of auriferous gravel available for dredging is 20 million cubic yards.

Platinum is reported to have been discovered in the township of McArthur, Northern Ontario. It is stated to be associated with pyrrhotite accompanying gold and silver. Platinum is found in the nickel ores of Sudbury district, which is located south of the above township. Sperrylite, platinum arsenide ($PtAs_2$) is found in small quantity in this district.

The installation of the Ross gold mill at Poplar, Lardeau Valley, B.C. is completed and crushing has commenced. The ore of this mine is of a peculiar character; besides free gold, it contains an extraordinary assortment of other metals. Samples revealed platinum, gold, copper, silver, lead, gallium and cinnabar. The ore awaiting treatment contains about \$30 of gold per ton.

Options on mining claims involving a sum of \$500,000 were recently taken by Mr. W. Rukeyser, mining engineer of New York representing the British Exploration Co., of New York and London, upon properties at Elbow Lake, north of The Pas, Northern Manitoba. The bonded properties are chiefly free gold and copper claims. The Hollinger interests of Northern Ontario have taken over the Murray claim in this district.

The Premier Mining Co. has recently acquired one-third of the capital stock of the British Columbia Silver Mines, Ltd. These properties adjoin each other. The control of the B.C. Silver Mines, Ltd., is in the hands of the British Canadian Silver Corporation, Ltd., a British company with head offices in London, and capitalised at £400,000 sterling. This deal appears to indicate that the Premier Co. is satisfied with the prospective value of the holdings of the B.C. Silver Mines.

The smelters of Canada and the United States have, in the past, penalised the owners of the silver-lead-zinc mines in the Kootenay district, B.C., upon all ores containing zinc, and the penalty has been enacted according to the proportion of the zinc content. This has ceased. The Consolidated Mining and Smelting Co., Ltd., has announced that it will pay for the ore on a straight basis, including the zinc content. When in full operation, the Kootenay mines produce, per annum, ore carrying from 50-60 million lb. of zinc. The silver-lead-zinc mines of Omenica and Atlin will also benefit by this decision.

The Cotton Textile Industry.—In 1920 the production of this industry was as follows:—Selling value of goods at factory \$92,490,002; capital invested in 31 plants \$76,413,703, of which \$51,898,032, was in Quebec. There were thirteen mills in Ontario, thirteen in Quebec, four in New Brunswick and one in Nova Scotia. Materials used cost \$53,402,723, including 90,233,395 lb. of raw cotton valued at \$33,824,168. The exports of the cotton textile industry were valued at \$2,518,368; and the imports at \$106,775,034, of which \$41,320,206 was for raw materials, \$11,965,539 for semi-manufactured products, and \$53,489,289 for manufactured articles.

Rubber Manufacture in 1920.—During 1920 there were 24 plants manufacturing rubber goods in Ontario and 11 in Quebec, employing respectively 10,065 and 5246 persons. The chief centre of the industry was in Ontario, but Quebec produced the greater portion of the rubber footwear. The total value of the rubber goods was \$55,122,857, and rubber footwear \$25,594,451. The capital invested in rubber-goods factories was \$42,249,456, and in rubber-footwear plants \$16,120,583. Materials used for rubber footwear cost \$11,192,995, the principal items being \$2,644,474 for raw rubber, \$804,967 for reclaimed rubber, \$876,628 for shoe duck, and \$933,347 for chemicals. The materials used in rubber-goods plants were valued at \$30,645,207, and included 17,656,734 lb. of raw rubber (\$9,302,141), 5,371,026 lb. of reclaimed rubber (\$863,537), tyre-duck valued at \$11,644,368, and hose- and belting-duck at \$1,848,256. The imports of tyres were valued at \$2,299,760 and rubber footwear at \$328,453; the respective exported values were \$10,267,534 and \$10,267,534.

The Ceramic Industry in Saskatchewan.—At the 20th annual convention of the Canadian National Clay Products Association recently held in Toronto, Prof. W. G. Worcester gave an outline of the work being done in ceramics by the Saskatchewan Government and University. Saskatchewan has vast clay resources, but owing to the failure of several plants in the province during the past few years the Government took action which resulted in the provision of a ceramic course at the University. The ceramic resources have been surveyed, the materials classified, and many changes in industrial methods have resulted. A publicity campaign has also been undertaken. Among the clays tested up to the present time, from only a small portion of the province, are fireclays, china, terra cotta, paving-brick clays, and clays for paint and paper manufacture.—(*Ind. Canada, Mar., 1922.*)

UNITED STATES.

Gypsum in 1920.—The output of gypsum in the United States in 1920 attained the record figure of 3,129,142 short tons, a gain of 29 per cent. compared with 1919. Owing to higher costs of production and the larger output of gypsum boards, etc. (valued at \$6,091,617), the value of the sales of gypsum products rose by 56 per cent. to \$24,533,065. Production was distributed as follows:—Uncalcined: for Portland cement, 541,901 t.; agricultural gypsum, 107,443 tons. Calcined: plaster of Paris, wallplaster, etc., 1,561,818 t.; Keene's cement, 16,542 t.; dental plaster, 1731 t.; for glass manufacture, 15,637 t.; as boards, tiles, blocks, etc., 308,756 t. Agricultural gypsum showed the largest proportionate increase, the consumption rising from 39,973 to 107,443 t. The most important event in the industry during 1920 was the purchase of the capital stock of the American Plaster Co. and the Bestwall Manufacturing Co. by the Beaver Boards Co., which now controls plants in six States. Imports included 232,000 t. unground and 15,000 t. of ground or calcined gypsum, increases of 64 and 63 per cent., respectively, over

the imports in 1919. Exports declined in value by 62 per cent. to \$436,132, due to reduced exports to Canada, England and Japan; Cuba, Australia and Canada were the largest buyers.—(*U.S. Geol. Surv.*, Aug. 31, 1921.)

UNITED STATES.

Industrial Uses of Phosphoric Acid and Phosphates.—Excluding phosphatic fertilisers, the phosphate industry possesses three main branches, viz., phosphoric acid, calcium phosphate, and sodium phosphate. Orthophosphoric acid is used chiefly in defecating sugar, for which purpose it is sold in various concentrations and free from arsenic and deleterious impurities; iron and aluminium salts need not be entirely removed and mono-calcium phosphate is generally present. It may be sold as a paste containing 47 to 50 per cent. of available P_2O_5 , or as a semi-dry mixture with silicate bases such as fuller's earth or kieselsuhr and containing 38 to 40 per cent. of available P_2O_5 . This acid is also employed in the manufacture of jellies, preserves and beverages. Syrupy phosphoric acid (85–88% H_3PO_4) is used in preparing pharmaceutical compounds, but lower concentrations of less purity are suitable for the manufacture of hydrogen peroxide and metallic glycerophosphates. Acid of 50 per cent. strength is used in the metal industry for pickling and making rust-proofing compounds. Monocalcium phosphate is mainly employed in making baking powder and self-rising flours; formerly manufactured solely from bone, probably 95 per cent. of the calcium phosphate now added to food products is of mineral origin.

The industrial uses of sodium phosphates are very extensive, and in 1920 the production in the United States was over 30,000 short tons. Monosodium phosphate finds limited application, but when manufactured by a special process to counteract its hygroscopicity, it is used in baking powder, etc. Disodium phosphate is much used in the dyeing and textile industries, for water-softening, and for medical and dental purposes, but the trisodium salt is the most important, being utilised in the laundry, paper, and other industries. Acid sodium pyrophosphate serves as a substitute for cream of tartar.—(*Chem. and Met. Eng.*, Feb 1, 1922.)

SOUTH AFRICA.

Output of Minerals and Metals in 1921.—Provisional statistics of the output of minerals and metals in the Union of South Africa and Southern Rhodesia during 1921 are given below; those relating to the Union are from returns compiled by the Government Mining Engineer and those for Southern Rhodesia by the Secretary of Mines, Salisbury.

	South Africa.	Southern Rhodesia.
Gold (fine oz.)	8,128,722.789	585,524.99
Silver (fine oz.)	830,339.096	152,988.80
Diamonds (carats)	808,586.27	141
Coal (tons)	11,389,015.000	574,753
Copper	158,270†	3,079.94
Tin	1,430,806‡	5.01
Arsenic (white)	2,000	361.27
Chromic ore	—	50,187.72
Iron ore	2,416,010	—
Lead ore	211,524	—
Manganese ore	303,000	—
Tungsten	—	17.25
Zinc	1,280,340†	—
Asbestos	5,122,438	19,528.71
Corundum	122,750	—
Graphite	46,767	—
Iron pyrites	4,352,645	—
Magnesite	1,452,000	—
Mica	1,263	85.23
Mineral paints (iron oxide, ochres, etc.)	117,000	—
Soda	311,625	—
Talc	413,000	—

† Ore and concentrates.

‡ Concentrates and metallic tin.

The output of the Union is valued at £43,028,974 and that of Southern Rhodesia at £4,720,375.—(*S. Afr. J. Ind., Mar., 1922.*)

FRANCE.

Additions to the French Pharmacopœia.—By a decree dated March 30, the following new substances are inserted in the French pharmaceutical codex:—Colloidal silver, diacetylmorphine hydrochloride (heroin), emetine hydrochloride, ethylmorphine hydrochloride, potassium gnaiaecol sulphate, sodium perborate, and zinc peroxide. Short descriptive articles are given concerning the properties and uses of, and the tests for, these substances. The article "Teinture d'iode" (tincture of iodine) is suppressed and the title "Teinture d'iode iodurée" is replaced by "Teinture d'iode officinale."—(*Rev. Prod. Chim.*, Apr. 15, 1922.)

Exports of Minerals and Metals from Madagascar in 1921.—Returns prepared by the Malagasy Bureau of Mines give the exports of minerals and metals from Madagascar in 1921 as follows:—Gold, 12,495.2 fine oz.; auriferous quartz, 2404.3 fine oz.; corundum, 285.013 metric tons; graphite, 6220.237 t.; rock crystal, 146.097 t.; mica, 140.749 t.; copper (? ore), 3.901 t.; and uranium (? ore), 5.940 t.—(*Bd. of Trade J.*, Mar. 30, 1921.)

GENERAL.

The Glass Research Association.—The second annual report summarises briefly the activities of the Association during the year 1921. The work enumerated falls into two classes: investigations into the properties of glass, and the design of apparatus and appliances for the increase of the general efficiency of the glass industry.

Under the first heading, work is being carried out on behalf of the Association at the National Physical Laboratory, in the Department of Glass Technology at Sheffield, and also in the laboratories of the Association which are now equipped. The work undertaken during the year includes the determination of the viscosity of glass over a large range of temperature at the National Physical Laboratory. Exhaustive investigations on the effect of chlorides, sulphates, and moisture on the properties and the melting behaviour of lead glasses have been carried out at Sheffield University and a very large amount of data is promised as a result of this work. Mention has also been made of the work on the expansion of thermometer glasses, devitrification, the presence of water vapour and occluded gases in glass, and the electrical conductivity of glass over a wide range of temperature.

In the second category, mention is made of the design of a draught-gauge, an oil-burner, a viscometer, a cracking-off machine, and a mould designed to obviate the necessity for using any form of paste. The effect of the coal strike and the bad conditions of trade is emphasised, and it is pointed out that on this account it has not been possible to obtain samples of various types of glass for examination, or to carry out the projected experiments on founding of glass. Reference is made to the loss incurred by members of the Association during the past year owing to failure of refractory materials. Work on this important subject is being undertaken in conjunction with the Refractories Research Association. It is pointed out that this work must of necessity be slow. The Research Association has visited the works of manufacturers of refractories with a view to co-operating with them for the production of better materials and improving technique.

Two numbers of the "Glass Research Association Bulletin" have appeared and in these the work of the Association is summarised. It is clear, however, that a large part of the benefits which the Associa-

tion is conferring on its members is due to the visits by the staff of the Association to the works of its members, and to the technical advice given on specified problems occurring in individual works.

Wet-moulding of Rubber Goods.—In a paper read recently before the Institution of Rubber Industry, Mr. S. J. Peachey gave an account of the latest development of his gas-vulcanising process, viz., the production of "peured" or wet-moulded goods. The process has already been applied to the moulding in a single operation of such articles as hot-water bottles, tobacco-pouches, galoshes, teats and surgical tubing, and its application is being extended in various other directions. The finished goods are transparent and may be produced in any desired shade of colour by the use of benzene-soluble dyestuffs.

Briefly, the process consists in preparing a 10–20 per cent. solution of masticated rubber in benzol or solvent naphtha (which must be free from pyridine and basic impurities), saturating with hydrogen sulphide, and mixing with a sufficient quantity of a standard solution of sulphur dioxide in benzol to yield a coefficient of vulcanisation of 2–2.5.

The mixed solutions are then poured into the moulds and these are allowed to remain at rest for an hour, after which time vulcanisation is complete. The moulds are then opened and the article in the form of a stiff gel is removed and dried on the core, which may conveniently be of the collapsible type to facilitate stripping. The drying operation may be aided by gentle heat, and in works' practice solvent recovery will be adopted.

A New Series of Dyestuffs.—Prof. A. G. Green announces the discovery in the laboratories of the British Dyestuffs Corporation of a new series of dyestuffs to which the name "lonamines" has been given. They are characterised by an affinity for silk and for "acetyl silk," but will not dye cotton. Further details are awaited with great interest.

Mica (1913–1919).—This pamphlet, published by the Imperial Mineral Resources Bureau (pp. 32, price 9d.), summarises information on the uses, production and consumption of mica during the war period. Mica is still obtained chiefly from India, Canada, and the United States; no serious competition has yet been felt from the important deposits in South Africa, Rhodesia, Tanganyika Territory, Australia, Brazil, and Argentina. It is expected that the manufacture of electric insulating material in Sweden from mica mined in the Bohuslän district will be established permanently in Göteborg. Good sheet-mica is reported to occur in Finland, but transport difficulties have prevented development. The world's production of mica in 1918 and 1919 is given below:—

	1918.	1919.
	Long tons.	
Nyasaland*	4	5
Southern Rhodesia	—	129
Tanganyika Territory*	17	9
South Africa	24	2,459
Canada	667	8
Ceylon*	6	2,955
India*	2,998	94
Norway*	65	7
Spain	8	1
Sweden*	5	18
Madagascar	4	3,599
United States†	2,780	—
Argentina*	169	152
Brazil	112	—

* Exports. † Chiefly scrap mica.

India is stated to have so great a producing capacity that little use has been made of the scrap mica, although the country possesses a monopoly of the production of shellac, the chief ingredient of the cement used in manufacturing mica-board (micanite), now an important industry in the United States.

PERSONALIA.

Prof. W. E. S. Turner has been elected president of the Society of Glass Technology in succession to Dr. M. W. Travers.

The Progress Medal of the Royal Photographic Society has been awarded to Mr. F. F. Renwick for his researches in the chemistry and physics of photography.

The Hon. Sir Charles Parsons has presented to the British Association £10,000 War Loan stock, which he has placed unreservedly at the disposal of the Council.

The Remington Honour Medal for 1922 has been awarded by the American Pharmaceutical Association to Prof. H. V. Army, of the New York College of Pharmacy.

Dr. Ellwood Hendrick, of New York City, will officially represent the American Section of the Society of Chemical Industry at the forthcoming Annual Meeting in Glasgow (June 4–11).

Mr. Charles Fremont has been awarded the Bessemer Gold Medal of the Iron and Steel Institute for 1921 in recognition of his services in the advancement of the metallurgy of iron and steel and the technology of the testing materials.

Prof. The Svedberg, of the University of Upsala, Sweden, will direct the research work and lecture on colloid chemistry at the University of Wisconsin, U.S.A., during the second semester of 1922–23 and the summer session of 1923.

The following Associates of the Institute of Chemistry have passed the examination for the Fellowship:—F. Hargreaves, A.R.S.M. (Metallurgy); A. G. Barnes, B.Sc., and J. E. Byles, B.Sc. (Foods, Drugs, and Water). The examination for the Associateship has been passed by: L. J. P. Byrne, B.Sc., G. W. C. Gardener, E. T. Illing, B.Sc., H. T. Jones, B.Sc., J. L. Raynes, B.Sc., F. S. Shadbolt (General Chemistry); H. Naylor and R. J. Philip (Organic Chemistry); and A. Sanders (Technology of Sulphuric Acid and its By-products).

The title of professor has been conferred upon the following lecturers:—University of Paris: M. Auger, analytical chemistry, M. Guichard, inorganic chemistry, M. Guillet, physics; University of Lille, M. Jouniaux, analytical chemistry. In Italy Dr. R. Biazzo has been appointed professor of general chemistry in the University of Naples; and in Germany, Dr. W. Strecker has been appointed ordinary professor of chemistry in the University of Marburg, and Dr. A. Gutbier has succeeded Prof. L. Knorr in the chair of inorganic chemistry in the University of Jena.

We much regret to record the death on April 25 of Mr. W. S. Curphoy, late Chief Inspector under the Alkali etc. Act.

From Italy are announced the deaths of Senator C. Saldini, director of the Royal Higher Technical Institute of Milan, and of Prof. G. V. Zanotti, director of the Institute of Pharmacological Chemistry and Toxicology in the University of Parma.

The following deaths have occurred in Germany: Dr. K. Bansa, director of the Chemische Fabrik Buckau, aged 54 years; Herr Max Voigt, formerly director of the Chemische Fabrik auf Aktien (vorm. E. Schering); Dr. K. Bornemann, professor of metallurgy in the Technical "Hochschule" at Breslau, aged 45 years; and Prof. M. von Unruh, well-known for his work on the liquefaction and fractionation of air, at the age of 52 years.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Dyes (France and Germany).

Major M. Wood asked the President of the Board of Trade whether he was aware that the *Compagnie Nationale des Matières Colorantes et de Produits Chimiques* was reported to have made an alliance with the German dye-trust (*Interessengemeinschaft*) under which the latter agreed to disclose its trade secrets provided the French company confined its sales to Franco and French colonies and paid 50 per cent. of the profits to the German trust. Dr. Murray asked whether Italy contemplated a similar arrangement.

In reply Sir W. Mitchell-Thomson said he had seen it stated that an agreement had been made between the French company and the German dye-trust, but he had no official information of its precise nature and he was not aware that it had been communicated to the Reparation Commission. The export of dye formulæ was not equivalent to the export of dyes and apparently such an agreement had no bearing on the Reparation clauses of the Treaty of Versailles.—(Apr. 26.)

Imports and Exports of Pottery.

Answering Lt.-Col. J. Ward, Sir W. Mitchell-Thomson said that several of the recommendations made by the National Council of the Pottery Industry regarding the classification of imports and exports of pottery had been adopted; for others a more detailed classification had been substituted; and the remainder had been combined into convenient classes. The Board of Trade had to restrict its requirements to particulars which could be furnished with reasonable accuracy, even if a different classification appeared more desirable on theoretical grounds. The Board had not refused to supply reliable statistics and information.—(Apr. 26.)

Rating of Machinery Bill.

On the motion for the second reading, Sir J. Remnant explained that the purpose of the Bill was to exclude machinery, unless fixed or attached to the hereditament, in assessing the rateable value of hereditaments used for trade, business, or manufacturing. The expression "fixed or attached" applied to all machinery or plant in or on the hereditament for producing or transmitting first motive power, or for heating or lighting, but not to machines, tools or appliances that could be removed without necessitating the removal of any part of the hereditament. The measure was necessary to clarify the system of rating in England and Wales; it was not needed in Ireland or Scotland. The motion was carried by 127 votes to 17.—(Apr. 28.)

The Budget.

The Budget for 1922-23 provides for a reduction in the standard rate of income-tax from 6s. to 5s., and abolishes the three-years' average in the assessment of all employees. The customs duty on Empire-grown tea is reduced from 10d. to 6½d. per lb. and that on foreign tea from 1s. to 8d., and there are corresponding reductions on coffee, cocoa and chicory. Postal rates on letters, post-cards and printed papers are lowered and £1,000,000 is available for concessions to users of telephones. The payment of arrears of excess profits duty is to be spread over 5 years with interest at 5 per cent.; farmers' assessments to be reduced from twice the annual value to the annual value, and land not used for agriculture will be assessed at one-third

the annual value. The sinking fund for the redemption of debt is to be suspended.

The total revenue for 1921-22 was £1,124,880,000 and the total expenditure £1,079,187,000. External debt was reduced by £71,379,000 to £1,090,184,000, but the national debt rose by £80,142,000 to about £7,654,500,000. For the current year income is estimated at £910,775,000 and expenditure at £910,069,000.—(May 1.)

Safety Lamps for Coal Mines.

The Coal Mines (Temporary Provisions as to Safety Lamps) Bill, "to restrict temporarily the powers of approving safety lamps under Section 33 of the Coal Mines Act, 1911," was read a second time on May 1.

Production and Exports of Coal.

Mr. Bridgeman stated, in reply to Mr. Gilbert, that during the first quarter of this year the total output of saleable coal in the United Kingdom was 61 million tons, and the total exports 13,250,000 t., representing increases of 7 million tons and 7,750,000 t. respectively, as compared with the corresponding period of 1921.—(May 1.)

Carbon-Monoxide Poisoning.

In answer to Sir R. Clough, Mr. Baldwin said that the Board of Trade had already given effect to the recommendation of the special committee appointed to consider this subject. All fatalities attributed to gas poisoning were reported by medical officers of health. There had been no marked change recently in the proportion of water gas supplied by gas undertakings.—(May 1.)

Duty on Sugar.

Replying to Captain W. Benn, Mr. Young said that the revenue derived from the excise duty on sugar was £122,000 in the financial year 1921-22. The anticipated loss of revenue involved in the proposed repeal of the excise duty on home-grown sugar was insignificant, and unless the duty was removed the two factories now working would be forced to stop.—(May 1.)

Use of Dyes in Purifying Sewage.

Sir A. Mond informed Lieut.-Colonel Pownall that his attention had been drawn to experiments on the use of dyes in the purification of sewage by the activated-sludge process (*cf. J.*, 1922, 146 R). As research would be needed to test the application of this and other discoveries to the activated-sludge process, he was inquiring into the best means of facilitating the necessary investigations.—(May 1.)

Dyestuffs (Import Regulation) Act.

Answering Mr. Doyle and Mr. Waddington, Mr. Baldwin said that since the passing of the Act until February 28 last applications for licences to import dyes had been granted for 3,150,841 lb. and refused for 1,871,217 lb., made up as follows:—From Switzerland: Granted 2,138,171 lb., refused 610,755 lb. From Germany: Granted 796,215 lb., refused 991,894 lb. From other sources: Granted 216,455 lb., refused 268,568 lb. (*cf. J.*, 1922, 112 R). German manufacturers had recently raised their prices generally, but they had reduced prices for dyestuffs which were also produced in Great Britain.—(May 1.)

British-America Nickel Corporation.

Mr. Baldwin informed Lieut.-Colonel Nall that under the scheme of reorganisation of this corporation, which took effect in 1921, the Government had exchanged \$3,000,000 first mortgage bonds for a

similar amount of A income bonds. No interest or repayment in respect of the capital of these bonds had been paid by the corporation.—(May 1.)

British Cellulose Company.

In answer to Mr. Ormsby-Gore, Mr. Young said that the company was forced to obtain more capital or go into liquidation, and the Government decided that it was preferable to relinquish its £750,000 preference shares than to permit liquidation or contribute further capital, especially as by so doing the company's position would probably improve, and with it the value of the shares retained by the Government. The shares surrendered were practically of no realisable value.—(May 2.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Aluminium Ware.—No information has been received that since the inquiry regarding imported aluminium and hollow-ware, market conditions have so changed that the British articles are now cheaper than the German and command a much readier sale.—(May 1.)

Agricultural Produce.—The resolution passed by the National Farmers' Union that the Act should be so amended as to bring agricultural produce within its scope is being considered by the Board of Trade and the Ministry of Agriculture.—(May 1.)

Cost of Administration.—The identifiable expense of administering and defending the Act does not exceed about £2000.—(May 1.)

Dumping.—Judging from the number of complaints received under Part II. of the Act, there is no ground for supposing that the dumping of goods in this country is increasing.—(May 1.)

GOVERNMENT ORDERS AND NOTICES.

THE SAFEGUARDING OF INDUSTRIES ACT.—Part I.—Complaints have been made that boric acid and metaldehyde have been improperly included in and that gallic acid and "R" tannic acid have been improperly excluded from the lists of dutiable articles. The complaints will be submitted to the Referee, and persons directly interested in any of them should communicate immediately with the Assistant Secretary, Board of Trade (Industries and Manufactures Department), Great George Street, London, S.W. 1.

Part II.—The Board of Trade has received a complaint that optical and other scientific instruments made in Germany are being sold in this country at prices below those at which similar goods can be profitably manufactured here. The complaint has been referred to a Committee, and the first hearing has been fixed for May 15, at 3 p.m., at the Hotel Windsor, Victoria Street, London, S.W. 1. All communications should be addressed to the secretary of the Committee, Mr. T. Turner, Board of Trade, Great George Street, S.W. 1.

A similar complaint made by the Association of Glass Bottle Manufacturers of Great Britain and Ireland in respect of glass bottles manufactured in Holland and Germany has been referred to a Committee, which will meet at 5, Old Palace Yard, Westminster, London, S.W. 1, on May 15, at 2.30 p.m. Communications should be addressed to the secretary of the Committee, Mr. G. S. Bailey, Board of Trade, Great George Street, London, S.W. 1.

REPORTS.

ANNUAL REPORT OF HIS MAJESTY'S INSPECTORS OF EXPLOSIVES FOR THE YEAR 1921. Pp. 30. London: H.M. Stationery Office. 1922. [Cmd. 1632.] Price 6d.

The number of explosives factories under continuing certificate of licence in 1921 was 117, of which 4 are in disuse, being 6 less than in 1920. There were 54 accidents in manufacture causing 5 deaths and injuries to 16 persons. Owing to the stoppage in the coal-mining industry the total number of accidents reported declined from 438 to 261, causing 35 deaths and injuries to 235 persons. The number of casualties was also much lower, viz., 35 against 50 deaths and 235 against 455 persons injured. Over 92.7 per cent. of the accidents causing death or injury occurred under conditions to which the Explosives Act does not apply.

Imports of explosives amounted to 442,829 lb. and included 339,045 lb. of aluminium torches.

The chemical advisers examined 356 samples, of which 6 were taken in connexion with accidents in mines. There were only 43 unsatisfactory samples, and of these only 20 were rejected for faulty composition. Thirteen new explosives were examined and passed and 11 samples were submitted by the Mines Department.

In consequence of complaints received from the Chief Inspectors of Explosives in South Africa and Victoria, Australia, experiments were carried out on the packing of gunpowder in bulk, and it was decided that dovetailed or lock-cornered cases should be used, and that 100-lb. cases should be capable of being dropped from a height of 3 ft. on to a concrete floor without becoming unserviceable.

During the year experiments with methane and petroleum-ether were carried out at the Rotherham Testing Station.

The total quantity of explosives used in mines and quarries during 1920 was 35,145,933 lb., as against 32,295,746 lb. in 1919.

REPORT ON THE ECONOMIC AND COMMERCIAL CONDITIONS IN THE GRAND DUCHY OF LUXEMBOURG, TO SEPTEMBER, 1921. By B. SULLIVAN, H.M. Commercial Secretary, Brussels. Pp. 21. Department of Overseas Trade. London: H.M. Stationery Office. 1921. Price 9d.

The mineral and metallurgical industries are by far the most important in Luxembourg, but agriculture employs a large percentage of the population, and there are minor industries such as brewing and the manufacture of earthenware and cement. As practically every industry depends on exportation, the country has suffered considerably from economic isolation, the erection of tariff walls, and the consequent loss of foreign markets for iron ore and metallurgical products. The output of iron ore improved to 3,704,390 metric tons in 1920 and the production of steel and rolling-mill products was also larger than in 1919, but that of iron declined. Output was still below the pre-war level, however, and the improvement was only temporary, as the year ended with a crisis which has not yet passed away. Throughout the year there was a shortage of fuel, despite supplies of German "reparation" coke obtained from the French Government, and of coal, largely from Germany.

Owing to the general economic situation it became necessary to find new openings for trade and in October, 1921, an economic agreement to last for 50 years was ratified with Belgium which provides, *inter alia*, for the suppression of the customs frontier between the two countries, the grant of a loan of 175 million francs to Luxembourg, and the forma-

tion of a joint commission to protect the interests of the metallurgical industries of both countries. It is possible that, in time, this agreement will be extended to include the French metallurgical industry (*cf. J.*, 1922, 80, 129 *n*).

Trade between the British Empire and Luxembourg is at present very small. In 1920 Great Britain supplied only 25,000 t. of coal and 3000 t. of pig iron, and India 25,000 t. of manganese ore. Complete trade statistics for the Duchy may be consulted at the Department of Overseas Trade.

REPORT ON THE INDUSTRIES AND COMMERCE OF SPAIN, DATED DECEMBER, 1921. By CAPT. U. DE B. CHARLES, *H.M. Commercial Secretary, Madrid*. Pp. 56. Department of Overseas Trade. London: *H.M. Stationery Office*. 1922. Price 1s. 6d.

Although Spanish industry was very prosperous during the war, little was done to develop it or make it more efficient. Consequently when prices suddenly collapsed the outcry for Government protection was loud and general, and the revival of acute foreign competition was one of the chief problems of the year 1921. Many tariff changes were made during the year, and a new strongly protective tariff is now awaiting definitive approval. Both import and export trades have declined. Since the armistice Great Britain has regained its premier position in the coal trade, but now that the Spanish mineowners have obtained protection it is considered unlikely that the consumption of British coal in Spain will again reach the pre-war amount. The year 1921, it is stated, was a disastrous one for both mining and metallurgical interests. The poor demand for iron ore was aggravated by the strike in Great Britain; and although Germany is buying more, Algeria and Tunis are competing with Spain in the export trade to the United Kingdom. The proposed export duty on Spanish pyrites will, it is thought, do great harm to the industry and probably lead to the loss of the American market.

The output of minerals and metals in 1920 was as follows:—

	Metric tons.
Anthracite	491,715
Coal, pit	4,928,989
Lignite	552,425
Coke, etc.	1,023,125
Lead and silver-lead ore	186,289
Iron ore	5,481,616
Copper ore	862,193
Zinc ore	94,095
Sulphur, native	77,030
Mercury ore	17,479
Manganese ore	21,256
Lead	175,195
Copper	22,458
Zinc	9,647
Mercury	861
Iron and steel	251,412

No statistics are yet available for 1921.

Strong protests have been made against the decree limiting the grant of mining concessions to Spaniards or to companies constituted and domiciled in Spain, on the ground that such action will hinder the development of national resources.

Among manufacturing industries, it is noted that certain branches of the iron and steel industry have been able to withstand foreign competition, but the manufacturers of aluminium kitchenware have failed in this respect. A Spanish-German combine has started to manufacture linoleum, and as the raw materials are produced in the country it is thought that the enterprise will be successful.

The production of olive oil in 1920 was 316,964 metric tons, compared with 336,394 in 1919; export restrictions were removed in September, 1920, and foreign sales increased. The cork trade was very depressed in 1921, and owing to the accumulation of heavy stocks of esparto in the

United Kingdom, business was very stagnant. Of beet-sugar, 94,762 tons was produced in 1920, the percentage of sugar per ton of beet being 9·66; in the same year the production of cane sugar was 6760 tons.

Exports in 1920 decreased in value by 286,345,000 pesetas to 1,010,103,000 pesetas (peseta=9·5d. at par, now about 8·6d.), of which 321,437,000 pesetas was for manufactures and 213,080,000 pesetas for raw materials. This decline was due chiefly to foreign competition and the restriction on exports of olive oil. Most of the lead, all the mercury and a large part of the copper was shipped to Great Britain. Imports increased in value by 359,563,000 to 1,443,862,000 pesetas (manufactures 640,971,000 pesetas; raw materials 451,501,000 pesetas). Germany has improved its trade in electric lamps, dyes, bottles, sheet and plate glass, and earthenware; Great Britain supplied most of the tin and tinplate, mineral colours, varnishes, and large quantities of tar, pitch, earthenware, vegetable oils, and paraffin wax; Belgium provided a large proportion of the iron and steel, and important amounts of lime, cement, and glassware; France has lost ground in the trade in pharmaceutical products, crude rubber, and vegetable colouring extracts. The feature of the year was the success of Germany in the Spanish import trade, much of which was obtained at the expense of the United States.

Statistics for the first 10 months of 1921 show that, compared with the same period of 1920, imports declined in value by 4 per cent. and exports by 26 per cent.

The immediate future of British trade with Spain depends largely upon the fate of the proposed new tariff; but it is noted that Spanish industry cannot supply all the home requirements, and British manufactures still have the reputation of being the best.

REPORTS ON LAC, TURPENTINE, AND ROSIN. *Indian Trade Inquiry, Imperial Institute*. Pp. 74. London: *John Murray*. 1922. Price 5s. net.

This publication contains the reports of the Special Committee appointed by the Imperial Institute Committee for India to consider the possibility of increasing the trade in Indian gums, resins, and essential oils with other parts of the Empire. Although India contributes about 94 per cent. (20,000 tons) of the world's annual production of lac, the state of the industry could be improved; it is not well organised, and adulteration of lac products is common. Recommendations are made for improving the efficiency of the industry, for maintaining standards of purity and quality, and for increasing the consumption of lac. The lac trade of Burma is considered in a short supplementary report. Special interest attaches to the possibility of obtaining supplies of turpentine and rosin from India, which is the only part of the British Empire that produces these raw materials in quantity. At present, although India possesses large areas of pine forest from which turpentine and rosin could be obtained, the country still depends on imported supplies. Development of the industry depends almost entirely on the provision of transport facilities in the forests, but it is estimated that production, which was 50,077 cwt. of rosin and 152,442 gallons of turpentine in 1920, should eventually reach 440,000 cwt. and 1,600,000 gallons, respectively. The Committee considers that every effort should be made to increase production and makes recommendations to this end. The publication concludes with a summary of information on the production and characters of Indian turpentine oil and rosin (*cf. J.*, 1920, 201 *n*, 1921, 306 *n*).

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for April 27 and May 4.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REFERENCE NUMBER.
Australia	Chemicals in bulk	454
"	Glass and crockery	483
Belgium	Insulating material	493
British India	Paints and driers (tender for)	†
Canada	Steel sheets for enamelling ..	8426/E.D./S.C. 2
"	Mica discs	•
"	Bond papers	•
"	Iron perchloride, zinc oxide, alumina (special), drugs, heavy chemicals, dry colours, dye-stuffs, varnish, gum, shellac	489
Cape Verde Islands	Electric incandescent lamp bulbs	475
Chile	Iron and steel, tinplate, galvanised sheets	517
Denmark	Safe explosive materials	4890, S.C.
Dutch E. Indies ..	Soap	480
Egypt	Crockery, palat, oils	510
France	Copper sulphate	464
"	Tinplate, black plates	407
Mexico	Tinplate, chemicals	482
"	Shellac	519
Morocco	Paint for ships, lubricants and packing for steam engines	477
New Zealand	Paint	450
"	Chemicals	460
Norway	Corrugated iron	465
South Africa	Cement (tender for)	8554/E.D./P.N.
Spain	Photographic materials	504
Sweden	Chamois and kid leathers	473
"	Oils of every kind	474
Switzerland	Rust-proof iron and steel	505
United States	Potassium permanganate, yellow prussiate of potash, crystal sugar of lead, naphthalene, senna	15224 F.W.
"	"	S.C. 2
"	Plg tin	511
"	Ammonium sulphate, pyridine, dry paint colours, white and red lead (dry and in oils), linseed oil	513

* High Commissioner for Canada, 19, Victoria St., London, S.W. 1
† Director-General, India Store Department, Belvedere Road, London, S.E. 1.

TARIFF. CUSTOMS. EXCISE.

Australia.—The final amendments to the customs tariff are published in the issue for April 27. Amyl alcohol, spirituous preparations, ethers and chloroform, aluminium, nickel, sodium carbonate and bicarbonate, sodium silicate, bleaching powder, chlorine, sulphur chloride, carbon tetrachloride, superphosphates, and saccharin are affected.

Austria.—Particulars of the proposed classification of and rates of duty on goods under the proposed new customs tariff can be obtained from the Tariff Section of the Department of Overseas Trade.

Belgium.—An export licence is no longer required for fodder- and cattle-food molasses. Owing to the application of customs duties on certain German goods, certificates of origin are required for such goods when imported from the

United Kingdom or European countries other than Germany.

British India.—A list of official valuations for assessing customs duties is given in the issue for May 4. Sugar, liquors, ores, oils, stearin, wax, manures, various heavy chemicals, drugs, medicines, dyes, paint, colours, tanning materials, superphosphates, and saccharin are affected.

Bulgaria.—The new customs tariff came into operation on April 10.

Cyprus.—The import duties on petroleum, paraffin, salt, and spirits have been revised.

Egypt.—Importers of alcoholic varnishes are required to state the percentage by volume of alcohol in the varnish, whether the alcohol is denatured, and, if so, the amount and kind of denaturant used.

Germany.—Import duties have been re-imposed on bone grease, waste grease, and oil dregs.

Gold Coast.—The export duty levied on kola nuts exported by sea has been removed.

Hungary.—The surcharge on customs duties (on goods other than those specified in lists "A," "B," "C") paid in paper currency is fixed at 16,900 per cent., i.e., 170 times the nominal rates.

Italy.—Export licences are no longer required for plates and wires of nickel alloys, platinum scrap, and quinine products.

New Zealand.—Goods liable to the depreciated currency surtax include paper, perfumery, metals, pipes, certain rubber goods, glass, earthenware, and manures.

Rumania.—The exportation is prohibited of natural and artificial tartar and any raw material of tartareous origin.

Spain.—A law has been passed empowering the Government to modify the customs tariff. The power to reduce duties by more than 20 per cent. may only be exercised within one year from the date of promulgation of this law.

Switzerland.—By a decree dated March 17, the right to import alcohol is reserved to the Alcohol Monopoly, but spirituous beverages may be imported by private persons on payment of the monopoly duty. Imported raw materials for distillation, on which monopoly duty has not been paid, may only be distilled on payment of a monopoly duty of 285 francs per hectolitre of absolute alcohol produced.

United States.—Copies of the Bill to revise the customs tariff may be seen at the Department.

COMPANY NEWS.

UNITED ALKALI CO., LTD.

At the meeting held in Liverpool on April 25, Mr. Max Muspratt dealt with the completed accounts for the year 1920, and the report for the year 1921. In spite of the slump at the end of 1920, the gross profit was £710,000, which included a large sum in respect of the writing-up of stock values, in accordance with the requirements of Somerset House for the purpose of excess profits duty. In that year the company paid in taxation nearly £296,000. The same conditions, in accentuated form, affected the figures for 1921, but with the abolition of excess profits duty and an approximate stabilisation of values, the general outlook was now more hopeful. In May, 1921, the debenture stock-holders agreed to an increase in that stock from £2,665,000 to £3,500,000, but so far it had not been found necessary to make any new issue. In 1921 no less than £500,000 was paid in taxes, and largely owing to that fact only a portion—4 per cent.—of the interest on the 7 per cent. preference shares had been paid.

The extension to the ammonia-soda works, said Mr. Muspratt, was started in December last, and the product was being well absorbed by the market and by the company's plants for caustic soda and soda crystals, which were now working at full capacity. At Newcastle, the electrolytic plants were working almost at full load, but the similar plants at Widnes were still working below capacity owing to the small demand for chlorine products. The position, however, was improving week by week. Grave agricultural depression, combined with other causes, had created absolute chaos in the fertiliser industry, and consequently the consumption of sulphuric acid was reduced to about 30 per cent. of the normal. The company's pyrites mines in Spain had been badly affected, and its copper works had been brought to a complete standstill. Developments in organic products, undertaken by the company to assist the dye industry, were at present under a cloud, partly owing to the great depression in the textile industry, and partly to the erratic policy of the dye-producers.

In seconding the motion for the adoption of the report and accounts, Dr. G. C. Clayton referred to the good relations which had existed between the company and its employees during the past year, in spite of reductions in wages, to the great progress made in developing new processes of manufacture, and to the prominent part played by the company at the British Industries Fair. It will be remembered that the chemical exhibits at the Fair, so well organised by the Association of British Chemical Manufacturers, were mainly fine-chemical products, but the United Alkali Company's exhibit was a conspicuous example of the enterprise shown by the heavy-chemical branch of the industry.

ASSOCIATED PORTLAND CEMENT MANUFACTURERS, LTD.—The setback in the cement trade in 1921, explained the Hon. F. C. Stanley at the recent meeting, was due to the disastrous effects of the coal strike, the inability to compete in the overseas markets with continental manufacturers, owing to depreciated currencies, and the Government's change of policy regarding its housing schemes. Profits also suffered considerably because of the necessity for writing down the value of stocks. There was no immediate likelihood that the price of Portland cement would recede to the pre-war figure; coal cost now fully 100 per cent. more than in 1914 (half a ton of coal was needed for every ton of cement manufactured) and labour was 130–140 per cent. above its pre-war cost.

The company is acquiring the Kent Portland Cement Co., Ltd., whose works have cost £2,000,000 and have a capacity of 3000 tons per week of cement. The purchase price is approximately a million less than the cost of the works and property. It is intended to form at an early date an Indian company to take over the cement works which the company, together with the British Portland Cement Manufacturers, Ltd., is erecting in India. The dividend for the year is 5 per cent. on the ordinary shares, and £224,043 is carried forward, as against £222,561 brought in from the previous year.

BRITISH CELLULOSE AND CHEMICAL MANUFACTURING CO., LTD.—Mr. Arthur Chamberlain, addressing the third ordinary general meeting on May 1, attributed the responsibility for the present state of the company's affairs to the experts and to the non-technical directors, and inasmuch as the Government had agreed to the issue, it must also have been deceived. There had been two errors. The first was in not realising that production was still in the experimental stage, and the second was in undertaking an immediate production of 9 tons of "acetyl" silk per day. The explanation of all the mistakes was contained in the two words "war

psychology." After a long discussion the report and accounts were adopted and resolutions sanctioning the reduction of capital were passed unanimously (*cf.* J., 1922, 181 n). The holding company which is to provide the new working capital has been registered under the title "Cellulose Holdings and Investment Co., Ltd." with a capital of £50,000 in a million shares of one shilling each.

NATIONAL EMPLOYERS' MUTUAL GENERAL INSURANCE ASSOCIATION, LTD.—The report for the year 1921 shows that in spite of the industrial depression, the Association has made good progress, the available income having increased from £72,000 to £117,000. The Association makes a speciality of issuing policies to the chemical industry, and has its own staff of trained engineers for instructing employers and employees in the methods of preventing accidents. The kinematograph is used in this work, and it is anticipated that by these means accidents will be reduced in number by about 50 per cent. within two years.

TRADE NOTES.

FOREIGN.

Imports of Dyes into the United States in 1921.—In view of the report that the United States is willing, under certain conditions, to accept German dyestuffs in part payment of the cost of its army of occupation, the following figures of the imports of dyestuffs into the United States during the last two years should be of interest:—

	1920.		1921.	
From:—	lb.	\$	lb.	\$
Germany ..	1,155,501	1,565,300	1,050,028	1,718,776
Switzerland ..	1,372,490	2,693,653	1,504,970	2,005,285
England ..	346,078	394,892	290,877	360,553
Other countries ..	612,304	604,957	260,480	360,754

It will be seen that Switzerland not only maintained first place in the import trade in 1921 but increased its share, although the total imports were smaller. The imports included coal-tar dyes and dyestuffs valued at \$12,985,277 in 1920 and \$11,225,688 in 1921, figures which include intermediates worth \$841,754 and \$356,865, respectively. Details of the imports of coal-tar products in the two years are given below:—

	1920.		1921.	
		\$		\$
Raw materials* :—				
Phenol .. (lb.)	192,692	19,848	214,135	22,849
Benzol ..	486,619	10,868	1,722,085	42,370
Cresol ..	10,318,070	901,381	3,353,882	253,886
Naphthalene ..	15,012,171	530,221	4,495,796	135,911
Creosote oil (gal.)	18,427,152	1,796,399	33,239,432	4,756,618
Tar and pitch (bbl.)	20,681	50,162	21,968	43,048
Other products ..	—	204,331	—	21,718
Finished products† :—				
Allizarin and allizarin dyes (lb.)	441,756	343,519	375,112	510,038
Dyestuffs and colours .. (lb.)	3,486,873	5,258,802	3,106,355	4,445,348
Indigo, natural ..	152,304	305,423	52,439	85,605
Indigotin, synthetic .. (lb.)	766,422	481,292	408,262	200,903
* Duty free.		† Dutiable.		

Imports of coal-tar products have thus fallen considerably, gains being shown only by phenol, benzol, and creosote oil.

Exports of Petroleum from the United States in 1921. The rise of 10 per cent. in the exports of crude oil from the United States in 1921 was due to larger shipments to Canada and the resumption of trade with Germany. The export of fuel and gas oil, amounting to 845,061,000 gallons, improved by 2 per cent., and that of "all other naphthas" by

5 per cent. Decreases (given in parentheses) were shown by illuminating oil 748,973,000 galls. (-14%), lubricating oil 289,317,000 galls. (-30%), and gasoline 274,832,000 galls. (-30%). These decreases were due chiefly to smaller shipments to the United Kingdom and France.—(*U.S. Com. Rep., Mar. 13, 1922.*)

Sodium Compounds in the United States in 1920.—The corrected and amplified figures relating to sales and imports of sodium compounds in 1920 are given below (the preliminary statistics were given in the *Journal* for June 15, 1921, 217 r):—

Sales of Chief Sodium Compounds, 1919-20.

	1919.	1920.
	Short tons.	
Sodium acetate	823	1,080
Soda ash	981,054	1,238,149
Salt cake	129,042	178,770
Sodium bromide	499	543
Glauber's salt	47,730	50,655
Sodium thiosulphate	32,212	24,868
Sodium ferrocyanide	5,437	2,930
Sodium nitrite	1,182	1,197

The total sales amounted to 9,166,551 tons, worth \$118,836,347 in 1919, and 9,899,448 tons worth \$139,252,477 in 1920.

Imports.

	1919.	1920.
	Short tons	
Soda ash	415	758
Sodium chlorate	19	281
Sodium cyanide	2,587	3,795
Sodium ferrocyanide	650	1,101
Sodium nitrate	456,466	1,480,510
Sodium nitrite	1,275	5,845
Sodium silicate	465	320
Sodium sulphide	531	619
Total imports of sodium salts ..	522,357	1,631,065

Among the exports in 1920 was 83,331 t. of soda ash.—(*U.S. Geol. Surv., September 30, 1921.*)

The German Soap Market, Jan.—Feb., 1922.—Official statistics of the German trade in soap show that whereas exports increased from 619.5 metric tons (14.4 million marks) in November, 1921, to 988.4 t. (26.1 mill. mk.) in December, they fell to 727.4 t. (20.4 mill. mk.) in January, 1922, and 386.1 t. (10.4 mill. mk.) in February. Exports of other soap products in January and February, 1922, were, respectively:—Soft soap, creolin, soap substitutes, 109.2 t. and 72.8 t.; hard soap, hard creolin, etc., 95.5 (total for both months); toilet soap, clay soap, soap pomades, 200 t. and 98.7 t. Although these figures show a loss when compared with those for November and December, 1921, they are higher than those for the same period of 1920. Complete statistics are not available for 1921, but in 1920 the export of 2082.1 t. (31.2 mill. mk.) was distributed as follows:—Danzig, 438.6 t.; Saar district, 592.2 t.; Alsace-Lorraine, 302 t.; Switzerland, 78.6 t. The former German territories and adjacent countries are the chief markets for German soap, but small shipments are also made to England, Czechoslovakia, Italy, the Balkans, and South America. Ground has apparently been lost in all these markets, except Danzig, Memel, and South America.

Imports of soap in January and February amounted to 76.2 t. (910,000 mk.) of hard soap, 17.1 t. (115,000 mk.) soft soap, 182 t. (2.8 mill. mk.) of soluble soap, etc., and 5.9 t. (118,000 mk.) of toilet and clay soap. The hard soap came chiefly from the Saar district and the United States, soft soap came from Holland and the Saar district, soluble soap from the Saar district, and toilet and clay soap from Spain and Holland. It will be seen that imports of soap from Germany are insignificant, and that German soap finds its chief markets in former German territories.

BRITISH.

Gumarabic Trade of the Sudan.—The season for the production of gumarabic in the Sudan lasts from July to September, and the yield depends largely upon favourable weather after the trees have been tapped. Production during recent years has been as follows:—1916, 13,480 tons; 1917, 16,613 t.; 1918, 16,349 t.; 1919, 15,445 t.; 1920, 12,038 t.; in 1921 the crop was estimated at 10,700 t. and prices at El-Obeid averaged \$3—\$3.20 per cwt. Of the 2,546,457 lb. of gum exported in 1920, Italy took 752,354 lb., the United Kingdom 562,404 lb., and the United States 87,149 lb. Australia, New Zealand, France and Japan purchased more gumarabic than the United States.—(*U.S. Com. Rep., Mar. 27, 1922.*)

REVIEWS.

POWER ALCOHOL: ITS PRODUCTION AND UTILISATION.
By G. W. MONIER-WILLIAMS. *Oxford Technical Publications.* Pp. xii+323. (London: Henry Frowde and Hodder and Stoughton. 1922.) Price 21s. net.

Having regard to the interest which is now being shown in alcohol as a prospective source of power, this work is very timely. A short preface points out that an industrial revival would probably cause the demand for motor fuel to outstrip the supply. The work is divided into eleven chapters and has a very full index. The introductory chapter on the motor-fuel question is eminently sane and well-reasoned. Many statistics are given as to oil-production and these are evidently up-to-date, though exception may be taken to the quoted average figure of motor-spirit yield from the whole of the American oilfields which is now known to amount to over 26 per cent. by volume of the total production of crude oil. Throughout the work the author gives his own reasoned conclusions but is nowhere insistent upon them, and is content to leave the well-selected data to carry their own story. Chapter II deals with the plant as a source of alcohol, and though it treats of modern theories of fermentation and the action of fungi and yeasts in a scientific manner, it is nevertheless written in a clear and interesting way. Chapter III, on the production of alcohol from starch and sugar, touches upon the technical points of conversion of starch into sugar, on fermentation, and discusses the modern "mucor" processes and the theory of distillation as applied to the concentration of alcohol and the usual impurities found therein. The following chapter deals with the economics of alcohol production from crops and it treats of all the materials which have been seriously proposed as possible sources of alcohol, both in this country and abroad.

The possible production of alcohol from cellulose materials is considered in Chapter V, and it would be difficult to find in any one book such a complete and well-balanced description of theory and practice as applied to this difficult problem. The synthetic production of alcohol is very well treated in Chapter VI, which is concerned primarily with the syntheses from ethylene and acetylene. The vexed question of Excise supervision and denaturation is then adequately discussed and the law obtaining with regard to these subjects in other important industrial countries is considered. The chapter on the outlines of the principles of the internal combustion engine is unusually good. The vast amount of literature which exists has been very carefully sifted, and the best and most modern work, that of

Ricardo, which is of the greatest importance, has been admirably abstracted and discussed. The concluding chapters deal with the chemical and physical properties of alcohol from the motor-fuel standpoint, the results of engine tests and an account of some of the fuel mixtures containing alcohol which have been proposed.

To every chapter is attached a list of references to the most important modern work upon the subject under discussion, and only those who are conversant with the widespread literature of some of the subjects covered will be able to realise the work that has attached to compressing within a reasonable space a fair and balanced statement of the position up-to-date. The motor engineer may consider that the chemical aspect of matters has been given too much prominence, but equally the chemist and the bacteriologist may think that the engineering and application side has been dealt with in too great detail. This is inevitable in a work of such general character. It would be difficult to see how a subject of such wide compass could have been better treated, and the work is one which may be recommended unreservedly.

W. R. ORMANDY.

DIE SCHWIMMAUFBEREITUNG DER ERZE. By PAUL VAGELER. Pp. 98. (Dresden and Leipzig: Th. Steinkopff. 1921). Price 4s. 4d. net.

In this small work the author proposes to explain the process used for the concentration of minerals by froth-flotation. Very scanty reference is made to the phenomena associated with the process. We are told that experimenters are coming to the conclusion that surface tension is not the ruling factor in flotation, but that the addition of suitable reagents to the pulp leads to the formation of highly complex giant molecules comprising mineral particles and air bubbles, which float to the surface in virtue of their diminished specific gravities. The formation of these giant molecules is ascribed to adsorption, which in its turn is explained in terms of electrostatic forces.

In reply it may be pointed out that it is possible, and even probable, that all molecular forces are essentially electrical in origin, and that surface tension itself is dependent on electrical attraction; the advantage of basing our explanation on surface tension and allied phenomena is that we are dealing with physical magnitudes which can be measured, and the mechanical forces called into play can be subjected to mathematical analysis. The idea of the formation of "complex giant molecules" serves no useful purpose in the explanation of flotation; it may be compared with the idea that a fish may be caught by causing it to combine with the bait to form a "complex giant molecule" which can be landed and secured by the fisher.

The book will prove of small use to the expert, since it can offer him little beyond vague hypotheses, whilst to the tyro it is equally useless since it does not describe the fundamental phenomena of the process. As an example of an impracticable refinement, the suggested use of the determination of the probable error of metallurgical observations by the method of least squares may be mentioned. Short sections deal with adsorption, the structure of the atom, and other modern ideas in course of development, but none of these sections would prove of use to anyone unacquainted with the subject. An ingenious differential manometer to be used in connexion with Jaeger's method of measuring surface tension (p. 60) may prove useful to the experimenter. The description of the different types of flotation machines (p. 78) is very brief and not particularly accurate. The book concludes with a list of German patents dealing with flotation.

EDWIN EDSER.

ORGANIC CHEMISTRY. By V. VON RICHTER, edited by R. ANSCHÜTZ and H. MEERWEIN. VOL. II. CHEMISTRY OF THE CARBOCYCLIC COMPOUNDS. Translated from the 11th German edition by E. E. FOURNIER D'ALBE. (London: Paul, Trench, Trubner and Co. 1922). Price 35s. net.

This translation of the eleventh edition of the second volume of the well-known "Richter-Anschütz" appears eleven years after the publication of the original, although organic chemistry is a branch of science which is notorious for rapid growth in matters of detail such as is dealt with in the original. For many years past graduate students of organic chemistry have been required in many (if not all) of the English Universities to be able to translate such easy German as would occur in a "text-book" which simulates a dictionary. The demand for such a belated translation is not, therefore, likely to be great. The nomenclature in this branch of Science has been standardised by the Publication Committees of this and the parent Chemical Society; but, apparently ignorant of this, the translator has produced an English version of this well-known book which cannot fail to amuse an organic chemist, but which may easily mislead others using the book for reference purposes.

The mis-translation of "Kohlenwasserstoffe" by "carbohydrates," the use of phrases such as the "progeny" of an acid, the "unity" of a terpene, the "alkaline" phenols, "nitrified benzol hydrocarbons," the "ring-alcohols of the hydroaromatic carbons," "link-isomeric hydrocarbons" (and its variant "linkage-isomeric"), "isomerisms," "prepositions" (meaning prefixes!) and Baeyer's "Tension" theory are sufficient examples to indicate the worth of the translation, which, however, is accurate in parts. The transcription of formulæ, references and numerical data appears to have been quite efficient.

ROBERT H. PICKARD.

APPLIED CALCULUS. By F. F. P. BISACRE. Pp. xiv. + 446. (London, Glasgow and Bombay: Blackie and Sons, Ltd. 1921). Price 10s. 6d. net.

"This book has been specially written for science and engineering students who desire to acquire a working knowledge of the Calculus, but whose preliminary mathematical equipment is slight." These words quoted from the wrapper of the book indicate the scope of the work, but though the intentions of the author are laudable, a perusal of the pages leads to the conclusion that his object can only be attained by bitter drudgery, much of it unnecessary on the part of the student.

It is perhaps fair to judge a work on the Calculus by the author's treatment of the 5 fundamental numbers; in this work the conception of 0—the vanishingly small infinitesimal—is developed exclusively by the method of limiting values, and in a fashion which is nearly as tedious as Newton's fluxions without giving the same insight, and which gives no greater conception of an infinitesimal than the much shorter method of differentials of Leibnitz; the treatment of e is purely and simply an evasion as being difficult. The author states on p. 237: "In elementary algebra we have

$$\begin{aligned} \text{if } Y &= \log_e X \\ \text{then } X &= E^Y. \dots\dots\dots(1). \end{aligned}$$

then lower down the same page, he gives the same pair of equations numbering them (2) and (3), and draws the conclusion that tables derived from these are inverse to each other; on the next pages he plots the graph of E^Y , and then that of $\log_e X$, and leads the student to discover the fact that the two curves are superimposable; next the tangent at the point

(0, 1) is drawn, and as the tangent line makes an angle of 45° with the two axes (this, however, is not apparent from the diagrams as the scale of Y is double that of X) he proves that the derivative of e^x is e^x ; of course, there are many more words than this, but this is practically how the student is introduced to exponential functions. Except that the student is expected to know that π is the ratio of the circumference of a circle to its diameter, this number receives little notice; the differentiation of $\sin X$ is explained by saying that—

$$\frac{\sin(X + \Delta X) - \sin X}{\Delta X} = \left[\frac{\sin \frac{1}{2} \Delta X}{\frac{1}{2} \Delta X} \right] \cos(X + \frac{1}{2} \Delta X)$$

and that the limit of this $1 \times \cos X$; to students who are not expected to have a knowledge of algebra beyond quadratic equations, the seeing of this equation means that they have advanced further in trigonometry than is usually taught to such; it is a pity that the much more simple and rational geometrical demonstration of $d \sin X / d x$ is not given. The number i is only just referred to, probably because the author has not realised that it is of use in applied calculus; it need only be mentioned that by developing the hyperbola as a circle whose equation is $X^2 + (iy)^2 = r^2$, the conception of the meaning of the hyperbolic sines, etc. is facilitated, and as the catenary is a curve of distinct practical use, it is seen that i should not be neglected in applied mathematics.

In the preface the author states that infinite series are avoided altogether as being difficult and unconvincing, yet he is driven to Taylor's series; surely there would be no greater difficulty in developing the idea of infinite series especially as the methods of evaluating the incommensurates and inter- and extrapolation depend upon these series, and a valuable weapon of approximate integration is lost by their neglect.

If the author's treatment of mathematics is open to criticism, so equally is his application; the use of examples taken from various branches of science does not in itself make the mathematics applied mathematics. The chief defects in the applied portion are first a lack of instruction to the student how to translate his language of facts into mathematical language, a fault frequently found in mathematical treatises, and second an absence of any discussion on many of the expressions that occur in practice, an omission noticeable specially in the chemical portion. Few chemical reactions occur in a simple manner and it is far more common to find that successive reactions at varying speeds take place, and the mathematics of such reactions is entirely neglected; if the author had referred to Harcourt and Eason's original papers (they are still worth reading) he would have found guidance for much useful material.

The book has some novel features. It is unusual to begin with Kepler rather than Newton and to introduce integration before differentiation; the idea is bold and good, as also the introduction of the human touch in biographical details of the masters of mathematics and physics. If the author had only had the courage to explain fully the differentiation of the three fundamental functions, x^n , e^x , $\sin x$, following up his idea of integrating at the same time, had tackled infinite series, as well as explaining the usual mathematical dodges, had shown how to translate facts into formulae, had applied mathematics to science as it is rather than to a simplified form, and last but not least had realised than an index adds to the value of a book, he would have produced a new, original and useful book; as it is he competes with such works as Sylvanus Thompson's, which is simpler, and Mellor's, which is much fuller.

H. DROOP RICHMOND.

OBITUARY.

ANDREW McWILLIAM.

The death of Dr. Andrew McWilliam has made a great gap in the ranks of English steel metallurgists. He is very sincerely mourned by all who knew him.

His public life seems to fall into three decades, the first two at Sheffield University, and the third away from it. The first decade is chiefly marked by his association with Prof. J. O. Arnold in the researches into the fundamental properties of carbon steels, and particularly of crucible steels. This work included the investigation of the micro-structure of the steels in the normalised, annealed, and hardened conditions. The second period saw the development of work and thought on problems of more direct practical interest. To this period belong his share of "General Foundry Practice," his papers on "The Elimination of Silicon in the Open-Hearth Furnace," and the series with Barnes on the mechanical properties of different alloy-steels after very varying heat-treatment. It also includes his work on high-speed steel and on electric furnaces. In the final period there appears more conspicuously the man of ripe and mellow experience, more concerned with the problems of the factory than those of the laboratory, not marked conspicuously by publications, but replete with fraternal intercourse.

Dr. McWilliam had an intensely attractive personality. This, more than anything else, has been responsible for his popularity—almost unique—amongst the steelmakers and metallurgists of this land.

L. AITCHISON.

PUBLICATIONS RECEIVED.

CHEMICAL TECHNOLOGY AND ANALYSIS OF OILS, FATS AND WAXES. Vol II. By DR. J. LEWKOWITZ. Sixth edition, entirely revised by G. H. WARBURTON. Pp. 959. (London: Macmillan and Co., Ltd. 1922). Price 42s.

SEWERAGE AND SEWAGE TREATMENT. By H. E. BABBITT. Pp. 531. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1922). Price 25s.

POWER ALCOHOL: ITS PRODUCTION AND UTILISATION. By DR. G. W. MONIER-WILLIAMS. Oxford Technical Publications. Pp. 323. (London: Henry Frowde and Hodder and Stoughton. 1922). Price 21s.

THE ANALYSIS OF FUEL, GAS, WATER AND LUBRICANTS. By PROF. S. W. PARR. International Chemical Series. Third edition. Pp. 250. (New York and London: McGraw-Hill Book Co., Inc. 1922). Price 12s. 6d.

ON THE ELECTRO-DEPOSITION OF IRON. By W. E. HUGHES. Department of Scientific and Industrial Research. Bulletin No. 6. Pp. 50. (London: H.M. Stationery Office. 1922). Price 6s. 6d.

THE PETROLEUM INDUSTRY: A BRIEF SURVEY OF THE TECHNOLOGY OF PETROLEUM. Edited by DR. A. E. DUNSTAN. Pp. 346. Institution of Petroleum Technologists, 5, John Street, Adelphi, London, W.C. 2. Price, 10s. 6d. to members of the Institution, 14s. 6d. to non-members.

NEW WHITE PIGMENTS.

C. A. KLEIN

Two interesting additions have recently been made to the somewhat limited number of white substances which can be satisfactorily used as white pigments. In view of the enormous number of white substances known, it might at first sight appear remarkable that so few are used as white pigments, but when the problem is closely investigated, it is found that in only a few cases do the available compounds possess the necessary combination of properties which are essential in a pigment.

Until recently, the standard white pigments have consisted of white lead, zinc oxide, basic sulphate of lead, and lithopone, and, although patent literature records almost countless efforts to produce substitutes or alternatives for any or all of these standard pigments, it is only within the last ten years that these standard pigments have been in any way seriously challenged.

However, to-day pigments containing titanium oxide and antimony oxide are recognised as products meriting serious consideration.

It has been customary in the past to apply the term "substitute" to any white pigment other than the recognised standard pigments, and, owing to the failure of almost all the substitutes previously offered, the word has been understood in the paint industry to indicate inferiority of the product as compared with the standard. There has been so much experience of this kind that the path of any new pigment is invariably thorny. The paint world is aware that the standard pigments are by no means perfect, and the more modern attitude is to recognise that as all pigments have definite limitations, their proper use lies in the application of the particular pigments most suitable for the specific purpose for which they are required.

The last 25 years have seen an increasing application of science in the paint industry, and although as yet there has been no organised effort for the scientific study of paints or painting operations, there is a number of reliable workers distributed throughout the world whose efforts are beginning to place the industry on a scientific basis. In the paint industry, where the physical properties of the materials frequently outweigh in importance the chemical properties, progress was necessarily slow until the so-called practical man could be induced to collaborate with other workers whose training had been on more scientific lines. In a paint works the chemist was too frequently conspicuous by his absence, or, if tolerated, was of the tame variety whose duties consisted in the checking and testing of raw and finished products, and whose opinion was usually only of secondary importance to those of the buyer or salesman.

The titanium-oxide pigments which have been described in a recent lecture before the Society of Arts (*cf.* p. 216 *of* this issue) represent years of patient work in Norway and America on a problem which has presented many serious difficulties, and the solution of which has resulted in a process and pigment having considerable interest from a purely scientific point of view, apart from technical value.

The same remark applies to antimony oxide, which has added interest in that its production and use were made technically possible by English chemists, and became a commercial proposition some five years ago. The first suggestion to use antimony oxide as a pigment appears to have been made in America some 30 years since, the method then proposed being, in principle, identical with the method now technically operated, *viz.*, the preparation of oxide from the native sulphide by

roasting with fuel in a cupola or similar furnace provided with an air blast. The earliest products had many inherent defects which rendered them unsuitable for pigment work, and these defects have now been overcome through the work carried out in this country.

It is now announced (*Times Trade Supplement*, May 6, 1922) that the manufacture of oxide of antimony as a pigment has been undertaken in Australia, antimony ore (from the Costerfield Mine) being used by the Antox Syndicate, Ltd., of Sydney, for this purpose. The process is stated to consist in treating the coarsely crushed ore in a blast furnace from which the oxide passes in the form of vapour through three expansion cooling chambers, thence onwards to a collecting baghouse, where it is collected in the usual bag collectors. It is stated that by varying the temperature at which the plant is worked, the colour of the product can be varied from pure white to dull orange.

The bag material is considered unique in that it is woven wool from which the natural fats have not been removed, and the efficiency of the material as a filter is ascribed thereto. The Costerfield Mine is regarded as one of the largest antimony mines in the world, and it is claimed that the oxide can be produced in Australia much cheaper than in Europe. Emphasis is laid on the fact that the process of production is entirely Australian and that no apparatus or ingredient is imported.

Apart from the chemical interest attaching to the process and product, the development must be viewed as further progress in the development of manufacturing operations in Australia. The world importance of Australia as a source of lead and zinc is a rapidly achieved result of a progressive policy, and the still more recent development in the manufacture of lead and zinc pigments in that country, together with the above-mentioned production of antimony oxide, shows clearly that Australia does not intend to remain content merely as a seller of raw materials and buyer of manufactured products.

There is little doubt that when the Australian home demand is satisfied by materials of local manufacture instead of, as hitherto, with those made in Europe from Australian raw products, then doubtless attention will be given to the near markets where the cost of carriage is in favour of the Australian producer. Formerly dependent solely on England for white lead, Australia is now herself a producer, and amongst the factories is one partly owned by the British Lead Manufacturers who formerly supplied the English-made product. Doubtless similar changes will take place in other industries.

Interest in the oxides of antimony and titanium pigments has been stimulated by the recent controversy as to the use of white lead which culminated at the International Labour Conference held at Geneva in November of last year, and, although both pigments appear to have proved suitable in certain directions, it cannot be said that sufficient experience has been gained to warrant the assumption that either is capable of being used as a complete alternative for white lead or zinc oxide. Extensive and prolonged tests must be made in this connexion with both pigments before it will be possible to say if, or to what extent, they can replace white lead for outside purposes. It is not as yet clear whether the use of white lead as a paint material will be in any way affected by the introduction of these pigments. Possibly they will replace zinc oxide and lithopone to a more serious extent.

It is necessary to point out that both of the new pigments are stated to give best service when mixed with zinc oxide, and unless some hitherto undisclosed merit is to be discovered, it is not probable

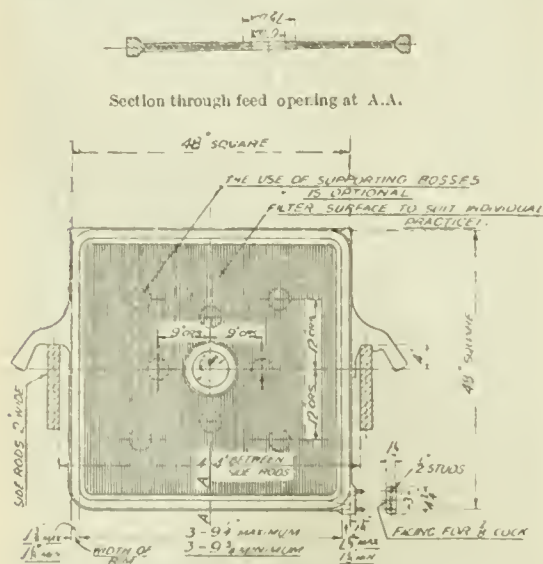
that these pigments will, as has been suggested, sound the death knell of the much abused but still serviceable white lead. Both pigments may prove of considerable use in the rubber and similar industries. The new pigments have been brought forward at a most opportune moment, and even if the ultimate demand for them does not satisfy the desires of their inventors, they can be assured of a permanent position in the list of standard white pigments provided they can compete economically with the other pigments now in use.

STANDARDISATION OF FILTER PRESSES.

It will be within the knowledge of many of our readers that a Joint Committee of the Association of British Chemical Manufacturers and the British Chemical Plant Manufacturers' Association is drawing up standards for filter-press plates. The final proposals for the standardisation of cast-iron filter presses will shortly be presented to the General Committee, and on acceptance will be sent forward to the British Engineering Standards Association. We shall be glad if those interested, after giving careful attention to this report, will forward any comments as soon as possible to the Secretary of the British Chemical Plant Manufacturers' Association, 166, Piccadilly, W. 1, so that they may have consideration before final adoption of the proposals.

The Sub-Committee has now completed its consideration of the replies to the questionnaire issued with reference to the original proposals, of which particulars were given in this *Journal* (1921, Nov. 15, 401 R). These proposals found a very large measure of acceptance, but some desire was shown for a 48-inch plate, and the Committee now puts forward suggestions concerning these, together with certain minor modifications of detail in the original plans. The proposals are as follows:—

(a) It has been decided to recommend a recessed plate of the 48-in. size with optional strengthening-bosses as indicated in the accompanying drawing (Sketch No. 1).

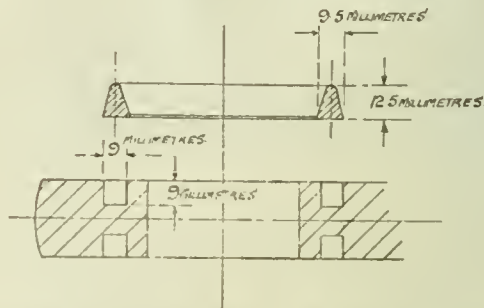


Recessed-Plate Type.

SKETCH No. 1.

(b) Only one type of 48-in. plate and frame is submitted, in view of the more restricted range of application of this size. After careful consideration of the conditions to be met in the case of those users who asked for such plates and frames, and also of the probable uses for which they may more commonly be required, it has been decided to adopt a top-feed in an external lug, to be suitable either for cloth sleeves or rubber-joint rings. In regard to the washing arrangements, the view is advanced that having regard to the great capacity of this press, it becomes economical to have a separate wash- and air-outlet to each chamber. This involves the use of an upper trough, but permits the fullest control of washing efficiency. It will be possible to use these wash-outlets and air-cocks as additional filtrate-outlets. The design proposed is shown in Sketch No. 2.

(c) It is proposed to fix dimensions for triangular rubber-joint rings and the grooves to receive them. The dimensions will accord with those of existing rings of this type, which are given in Sketch No. 3. Tests are being made to ascertain how rings and grooves to the nearest British dimensions will work together with those constructed for present practice. Full drawings will be sent on application to those who are interested.



Proposed standard sizes of inserted rubber joint rings on external lugs. Section of rings for all sizes.

SKETCH No. 3.

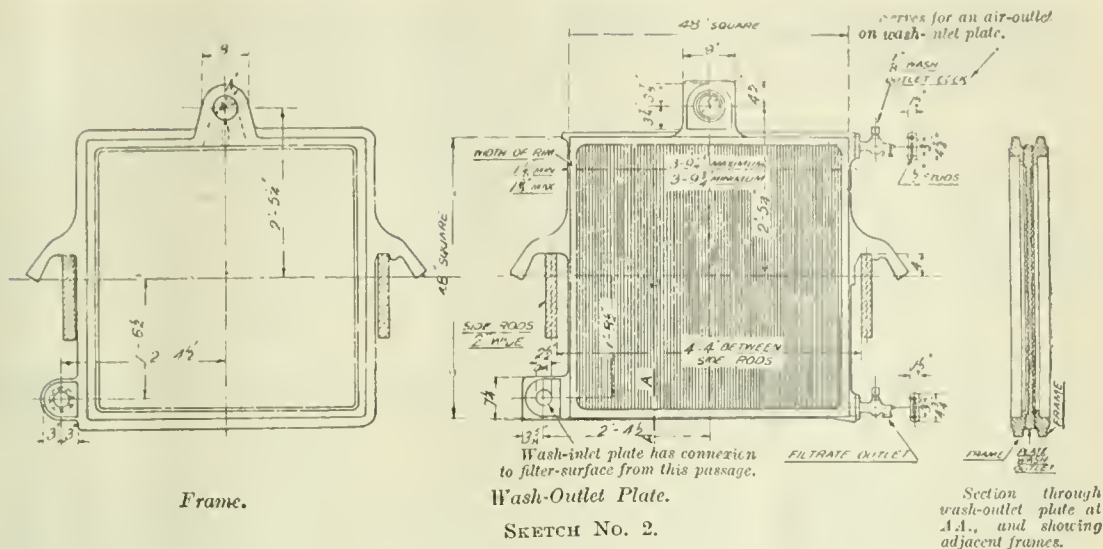
(d) In the case of the 32-in. size, it has been found that a working dimension of 31.5 in. is in better accord with the data before the Committee, and will work better with existing plates. The size of feed to the plate and frame-press of this size has been increased to 2½ in.

(e) It is proposed to modify the rim of the central-feed opening in recessed-plate presses to enable the same pattern to be used both for double cloths with sewn centres, and for cloth clips. The lip as cast will be half-round, and the thickness after tooling for use with clips is to finish to ⅝-in. thick for the 18½-in. size, ¾ in. for the 25-in. and 31½-in. sizes; ⅞ in. for the 38-in. size, and 1 in. for the 48-in. plate. The size of opening and outer diameter of the flange remain as before. Details are given in Sketch No. 4.

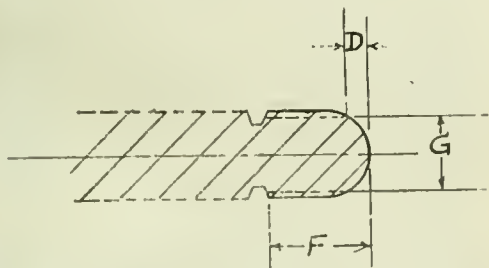
(f) It is proposed to allow the width of rim in all cases to follow the practice of individual makers within stated limits, the size of cake being subject to slight modifications accordingly. The maximum width of rim will be that given in the drawings, and the minimum width will be ⅝ in. less for the 18½-in. size, and ¼ in. less for the remaining sizes. The centres of ports in the internal-lug type of press have been slightly modified to make them suitable in all cases.

It is decided not to fix dimensions for the rims of frames so long as the latter are made to work together with the standard plates.

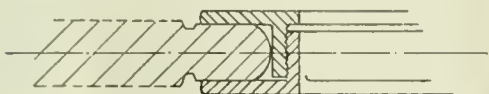
(g) In the 38-in. size, it is made permissible to fit plates with four strengthening bosses on the filter-



surface, to be used only where uneven filling is likely to arise. These bosses are to be arranged on diagonals of the plate, and at 8-in. centres from the vertical and horizontal centre line. A similar arrangement is adopted for the 48-in. plate, except that eight bosses are provided for.



Section through rim of feed-opening in recessed plate, to be tooled to dimensions for cloth-clips.



Clip fitted on tooled rim;

Table of Dimensions.

Size of press.	D.	F.	G.
In.	In.	In.	In.
18½	¾	1	1
25	¾	1	1
31½	¾	1	1
38	¾	1	1
48	¾	1½	1

SKETCH No. 4.

(h) Some minor modifications have been made to the centres of passages for external-lug presses.

(j) Standard identification marks for distinguishing wash-inlet and outlet plates, and frames, have been settled. These are to be cast on the filtrate (and wash) outlet side of the plates, near the top. Wash-outlet plates are denoted by a single button, and frames by a lozenge placed on the same side as the internal flange, thus denoting its position next to the wash-outlet plate. The wash-inlet plates are plain.

CLASSIFICATION AND VALUATION OF MEAT FOODS FOR PIGS AND POULTRY.

H. C. S. DE WHALLEY.

Meat foods for pigs and poultry are used to-day on such a large scale and in so many different forms that it has become necessary to introduce some sort of classification and systematic nomenclature. At present what is termed "bone meal" by one manufacturer may be called "meat meal" by a second, "meat and bone meal" by a third, whilst a fourth, doubtful of the precise meaning of any of these descriptions, may use the expression "pig or poultry food."

In the writer's view the connotations of the terms "meat meal," "meat and bone meal," and "bone meal" should be more clearly defined. It seems fairly obvious that a "meat meal" should contain a preponderance of meat with little bone, "bone meal" a preponderance of bone with little or no meat, and that "meat and bone meal" should contain approximately equal proportions of meat and bone. On this basis meals can be divided simply into three groups according to their bone content. As meat, compared with bone, contains very little mineral matter (ash), a knowledge of the ash content enables the meal to be classified as follows:— Bone meal, with over 45 per cent. of ash; meat and bone meal, with between 45 and 25 per cent. of ash; meat meal, with less than 25 per cent. of ash.

It might be thought that as the ash of these foods is mainly phosphato of lime, which is of much smaller feeding value for pigs and poultry than the albuminoid and fat contents, it would be better to base the classification upon one or both of the last mentioned; but as variations in the fat content are accompanied by variations in the albuminoids, a classification on these lines is not easy. The fat itself is less valuable than the albuminoids, so that it is not advisable to combine the two, and the most satisfactory method appears to be, first to group according to ash content and then to contrast the albuminoids and fat.

Accepting the standards mentioned above it is found that the albuminoids are usually present to the extent of 25 to 35 per cent. in bone meal, 35 to 45 per cent. in meat and bone meal, and over 45 per cent. in meat meal. Samples that do not fall within

these limits are found to be abnormally rich in fat or carbohydrate (vegetable), to be insufficiently dried, or to be derived from sophisticated material.

The following analyses show fairly typical examples of the three groups:—

Bone Meals.

	(1)	(2)	(3)	(4)	(5)
Moisture ..	5.98	0.56	8.39	5.71	4.33
Fat ..	1.46	3.53	6.16	5.99	8.46
Albuminoids ..	35.00	33.40	28.70	30.40	31.75
Ash ..	51.50	45.50	48.00	50.00	47.80
Undetermined ..	6.06	8.01	8.75	7.90	7.66
	100.00	100.00	100.00	100.00	100.00

Meat and Bone Meals.

	(6)	(7)	(8)	(9)
Moisture ..	7.10	6.15	7.73	6.26
Fat ..	13.01	9.91	11.74	10.51
Albuminoids ..	42.90	38.30	38.00	38.60
Ash ..	28.90	26.20	28.00	43.80
Undetermined ..	8.09	19.44	14.53	0.83
	100.00	100.00	100.00	100.00

Meat Meals.

	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Moisture ..	9.54	6.08	10.28	7.00	3.06	5.30	6.01
Fat ..	12.80	26.95	19.00	35.18	24.90	11.98	51.44
Albuminoids ..	54.00	55.50	10.69	43.00	62.00	70.40	30.85
Ash ..	15.00	7.20	2.50	5.30	7.40	5.40	3.80
Undetermined ..	8.66	4.27	56.63	9.52	2.04	6.92	7.90
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

In the five analyses of bone meal the albuminoids conform to the general standards. Bone meals rarely contain much fat and usually contain only small amounts of carbohydrates. The low fat content of the first two samples shows them to be extracted bone, and the higher fat content of the remaining three shows them to be what is generally known as "dried green bone," i.e., butcher's bone, ground and dried.

Steamed bone is purposely not shown, as the residual nitrogenous matter is low and of little value; this material is really only suitable as a mineral food, to make up deficiencies in lime and phosphoric acid.

The next group, meat and bone meals, consisting of bones with more meaty material, naturally shows a higher albuminoid content and less ash. Samples (7) and (8) are of interest chiefly because they contain high amounts of undetermined matter.

The meat-meal group usually includes such material as tankage, greaves, and meat cakes, all of which are fairly free from bone. Sample (10) can be described as a meat meal which is rich in ash, poor in fat, and has a moderate content of albuminoids, whereas (11) shows low ash, high fat, and moderate albuminoids; (12), containing 56.63 per cent. of undetermined matter, is not a meat meal; (13) has low ash and albuminoid contents, but a very high fat content; (14), rich in fat and albuminoids, is poor in ash, and (15), showing low ash, low fat, and very high albuminoids, is horseflesh almost free from bone; (16) has a very high content of fat and is typical of pork residues.

The following considerations are generally of use in evaluating a sample:—

Moisture.—The first essential of a meat food is that it should be well-dried. The maximum limit for moisture should be about 8 per cent. If the pro-

duct has been well cooked or dried at a high temperature, it will be sterilised to a certain extent and it may be kept for a fairly long time, even if the moisture content is above 8 per cent. As a general rule, however, sterilisation is imperfect and the presence of much moisture results in rapid decomposition, which is manifested by rancidity, growth of mites, moulds, and bacteria, followed by putrefaction. Bone meals containing 11 per cent. of moisture often turn mouldy within a very few weeks.

Rancidity.—The acid value of the extracted fat is a good criterion of the rancidity of the fat or the staleness of the sample. This value shows wide differences. Some bone meals that have evidently been dried slowly at ordinary temperatures or have been stored too long before drying, have an acid value as high as 112. The acid value of the fat from bone meals and from meat and bone meal ranges usually between 27 and 45; such samples have quite a fresh smell, but those with a higher acid value are distinctly sour. Fatty meat-meals in good condition have acid values as low as 5 to 10.

Carbohydrates.—The sum total of the moisture, fat, albuminoids and ash deducted from 100 gives a figure which is taken as the carbohydrate content of the meal. In fairly pure samples this is generally less than 5 and if over 10, added carbohydrate is present. Materials containing vegetables, such as hotel or restaurant waste, contain up to 20 per cent. or more and are less valuable on this account.

Albuminoids.—The nitrogen content, as determined by the Kjeldahl method, multiplied by the factor 6.25 gives what is known in America as crude protein, but what in this country is called, according to the Fertiliser and Feeding-stuffs Act, albuminoids, although it by no means consists entirely of true albuminoids. The nitrogen contained in steamed bone is of poor feeding-value. Some bone meals contain a good deal of glucy material which is decidedly inferior to meat fibres or muscular tissues. Pork residues are not easily digested by poultry. The small amounts of hair, skin and even feathers sometimes found in meat meals give a fictitious value to the nitrogen content.

Ash.—The ash from bone meals and meat and bone meals consists mainly of phosphate of lime, with up to 2 per cent. of silica. Samples of so-called meat meals examined by the author were found to contain over 50 per cent. of ash, which was almost completely sand. Such cases are abnormal.

Colour.—This varies from whitish in bone meals up to nearly black in some greaves or tankage. Most meat and bone meals have a light brown colour specked with white bone, but are darker if much vegetable is present.

Quality.—This is judged first by analysis (whether bone meal, meat and bone meal, or meat meal); by the albuminoid content and the class of material from which the albuminoids are derived. A fair amount only of fat and bone is desired, but little bone should be present in meat meal.

From these details, together with the degree of freedom from carbohydrate, the rancidity, or the excess of moisture, a good idea of the value of the food should be obtained.

A somewhat abnormal meat meal was recently examined by the writer and found to contain:—Moisture 10.1%, fat 4.5%, albuminoids 84.5%, mineral matter 3.5%; total 102.6. The meal was fairly light coloured, fresh-smelling, dry, free from bone, and easily ground. As the sample, on breaking and grinding, was found to be of a glucy nature, a more complete examination was made of the nitrogenous constituents according to the method described in this Journal (1919, 841 A). The total nitrogen content of 13.52 per cent. consisted of:—Glue nitrogen 5.97%; amide nitrogen 0.72%; and

albuminoid nitrogen 6.83%, the factors used for conversion into glue, amide, and albuminoids being 5.57, 4.72 and 6.25, respectively. The analysis is therefore better presented as follows:—Moisture 10.1%; fat 4.5%; nitrogenous substances: albuminoids 42.7%, glue 33.2%, amide 3.4%; mineral matter 3.5%; undetermined 2.6%; total 100.

Gelatin or glue is notably deficient in the amino-acids tryptophane, cystine and tyrosine, and contains a large amount of glycine and much proline. These constitute the great difference between it and vegetable or animal proteins; and the much lower feeding value of gelatin is evidently determined by these differences.

NEWS FROM THE SECTIONS.

CANADIAN PACIFIC.

At a meeting of the Section held in the Board of Trade Council Rooms, Vancouver, on April 7, addresses were given on the subject of "Prospects for Commercial Drug Plant Cultivation in British Columbia" by the following members of the staff of the University of British Columbia: Prof. R. H. Clark, Department of Chemistry; Prof. A. H. Hutchison, Department of Biology; and Prof. John Davidson, Department of Botany.

Dr. Clark made a preliminary verbal report on certain researches being carried out under a grant from the Honorary Advisory Council for Scientific and Industrial Research in Canada. Following suggestions obtained by consultation with experts of some of the larger wholesale manufacturing drug companies in eastern North America, a list of native drug plants has been selected for investigation and related economic and scientific factors are being studied.

Last year a paper was published on "The Salicin Content of British Columbian Willows and Poplars" (Amer. J. Pharm., 93, 618, Sept., 1921). The subject of Cascara-Sagrada extracts from *Rhamnus purshianus* DC., is now being investigated. Much information has been obtained on the chemical composition and the physiological effects of extracts made from various materials gathered directly from growing trees of different ages and prepared under special conditions of ageing and treatment. In this work the co-operation of the medical staff of the Vancouver General Hospital has been of invaluable assistance. The world's annual consumption of Cascara bark is estimated to be 10,000 tons and the wholesale buying price has advanced from 8 cents per lb. in 1914 to 25 or more cents per lb. at present. Owing to the destruction of Cascara trees in British Columbia by Asiatics, who gather most of the bark, the natural supply is becoming rapidly depleted, and proposals are being made that the Government should take action to conserve this natural resource.

Dr. Hutchison illustrated by tables and curves certain results obtained in the physiological standardisation on cats of digitalis extracts, which had been made under varying conditions of time and temperature from leaves of locally-grown *Digitalis purpurea*, Linn.

Prof. Davidson discussed possibilities of developing a medicinal-plant industry in British Columbia, and emphasised the importance of economic, chemical, and biological preliminary investigations. Scientific and commercial data were given concerning forty native medicinal plants, most of which are being successfully grown in the University Botanical Gardens at Point Grey, near Vancouver. The extremely wide range of soil and climatic conditions obtaining in British Columbia makes it possible that several non-indigenous plants could

be successfully introduced, as has already been demonstrated in the case of certain fruits, flowers, vegetables and cereals. Prof. Davidson advocated Government assistance for Cascara reforestation, instancing the success of cinchona and rubber plantations in the East.

During the discussion a communication was read from Mr. C. J. Berkeley, Biochemist at the Marine Biological Station, Nanaimo, B.C., relating to the growing of the sautonin-yielding *Artemisia* in British Columbia. Prof. Davidson stated that he had obtained *Artemisia* seeds from Russia and France before the war, but that none of them had developed in the moist climate of the coast; they would, however, probably thrive in the interior of the province.

A suggestion was made that poppies might be grown locally for the legitimate manufacture of medicinal opium and its alkaloids. In this connection reference was made to the production of 1,209,600 lb. of raw opium in British India in 1920 and to exports during the same year of 1,473,080 lb. of this material (cf. J., 1922, 82 r). Two instances of the cultivation of poppies on a considerable scale were reported. In one case, the growers, who were Germans, claimed that the poppies were being allowed to ripen for the seeds, which were used in the making of puddings. In the other case, a Japanese had a field of ten acres located in a remote part of the interior, entirely planted with poppies and surrounded on all sides with a deep border of tall sunflowers. No satisfactory explanation could be elicited from the poppy-growing Oriental as to his motives, so the crop was destroyed by Government officials. Thus the first attempt at growing "drug" plants in British Columbia was nipped in the bud.

MONTREAL.

The following officers were elected at the annual meeting, held on April 27:—Chairman: Dr. A. R. M. McLean; Secretary-treasurer: Mr. W. B. Woodland; Committee: Messrs. H. W. Matheson, H. J. Roast, J. R. Donald, F. E. Cornell, A. G. Fleming, M. C. C. McFee, and F. W. Horner. The offices of secretary and treasurer have now been combined, in accordance with a resolution passed at the meeting.

MANCHESTER.

The eighth meeting of the session was held on May 5 with Dr. E. Arden in the chair. Mr. R. A. Bellwood, of Hull, read a paper on "The Progress of Vegetable-Oil Extraction," in which he described the development of oil-pressing machinery from the earliest times.

About 3000 B.C. a press was used in Egypt consisting of a strong wooden framework and a stout stuff bag, which contained the material to be pressed and which was suspended horizontally between vertical posts and subjected to a wringing and squeezing pressure. Vitruvius mentions oil-presses provided with very long levers, and Pliny (A.D. 23) describes a mill for grinding olives which resembled that in use at the present day, except that the stones were concave instead of flat. Generally speaking, the ancients used what is commonly known as the "pestle-and-mortar" press. The mortar was made from a tree-trunk and lined usually with box-wood; the pestle was a long pole to which a rolling motion was given by means of a rope-device worked by bullocks. A modified form of this press is still employed in India and China, and was made for £20 before the war. Next came the "wedge" press; in this the seeds, after being ground, moistened and tempered with steam, were placed in a straw bag in a container below two

heavy beams and pressure was applied by forcing the beams apart with a long wedge driven in by a hammer.

Stamping mills were used in the 10th century, and in the 17th century the Dutch improved the "sledgehammer" press by introducing a "stamper" press made almost entirely of wood. At least two of these mills were operating in Hull in 1810. They were succeeded by the Bramah hydraulic press, which revolutionised the industry. Probably the hydraulic press was first used in England in 1814, in Germany in 1818 and in France in 1819. Steam-jacketed kettles were introduced some time after 1787, and the "four-box" hydraulic press was employed in Hull about 1830. This press was fitted with four boxes which received four canvas or hair bags full of seed and produced 64 lb. of cake or meal at each operation; the press-ram was of 12 in. diam. and the stroke was about 10 in. In 1847 James Robson proposed to replace hair cloths by perforated metal plates, and in 1856 W. E. Newton patented a device for continuously feeding material to the stones and removing it when ground. A cake-moulding machine and press for making 16 cakes in one operation was patented in 1856 by W. E. Newton, but this great invention apparently escaped notice, as patents for 16-plate presses were taken out by independent workers in 1872 and 1874. Mills built on the "Anglo-American" system were introduced in 1874, and in 1878 E. R. Walker invented the hydraulic accumulator and a hydraulic moulding machine. The invention of the Anglo-American press brought many other improvements in its train: grinding machines were improved, larger cooking kettles were employed, greater attention was paid to the heating and tempering of the seeds, and devices were adopted for transmitting the seeds more quickly from the kettles to the moulding machine.

The author described a modern automatic machine which served 12 presses and was easily worked by one man; and methods of operating modern oil-mills and their machinery were illustrated by a kinematograph film.

The hon. secretary's report states that, although many members of the Section have changed their addresses during the past session, the membership has been well maintained and the attendances have on the whole been larger than usual. At four of the meetings the attendance was exceptionally good, viz., on the occasion of the chairman's address and the exhibition of chemicals; the meeting with the Chemical Engineering Group at which Dr. Bush read his paper on electrical precipitation; the joint meeting with three other societies on January 6 when Dr. Harden gave his address on biochemical method; and the recent meeting to hear the paper by Mr. Fairbrother and Dr. Renshaw on the relation between chemical constitution and antiseptic action in coal-tar dyes. Owing to economic reasons a supper and social evening were held instead of the usual annual dinner.

The officers for the past session have been re-elected for the next, and the following have been elected to fill vacancies on the committee:—Dr. T. Callan, Dr. H. F. Coward, Mr. A. Grounds, Mr. E. Melling, and Dr. F. M. Rowe.

NOTTINGHAM.

The sixth meeting of the session was held on May 17, when a contribution from the Textile Research Department of University College was read by Mr. S. R. Trotman.

The chlorination of wool is an empirical process which is difficult to control. Either the goods are not rendered unshrinkable or they break down in washing and lose weight unduly. The stages are marked by change in appearance and finally by

destruction of the epithelial cells with the appearance of *striae*. The extent of the chlorination can be estimated by a microscopic count of the altered fibres. Generally associated with chlorination are also a decrease in tensile strength, an increase in elasticity, and an increased affinity for dyes, but these changes do not become marked until long after the safety limit has been passed. Bleaching formulæ and the processes ordinarily employed inevitably lead to the production of free chlorine which is almost certain to cause damage. The author demonstrated by tables and diagrams the advantages of substituting hypochlorous acid prepared by the action of boric acid on bleaching powder, or by the action of chlorine upon an excess of calcium carbonate.

In the discussion which followed, the representative of the Nottingham Chamber of Commerce announced the opening of a Dyeing Department at the University College and the appointment of Mr. Trotman as lecturer.

YORKSHIRE.

At the annual meeting of the Yorkshire Section held in Leeds on May 8, the chairman, Mr. S. H. Davies, gave an address on "Micro-Organisms in Industry." To limit the scope of the address he excluded any reference to ordinary processes of brewing and distilling, wine and vinegar making.

After describing the saccharification of starch in the amylase process by means of *mucor* and *B. mesentericus*, Mr. Davies discussed modifications that have recently been brought about in alcoholic fermentation under the following heads:—(a) The production of glycerin; (b) the production of aldehyde; (c) the formation of fat in yeast from carbohydrates; (d) the wartime production of "mineral yeast" in Germany as fodder for cattle and foodstuff for humans. A description of Fernbach's well-known process for making butyl alcohol and acetone was followed by a description of the various acid fermentations, resulting in the production of acetic, butyric and lactic acids from molasses, cereals, potatoes, etc., and of citric, oxalic and fumaric acids from sugar. An allusion was made to Dr. Fowler's recent suggestion for the production of power gas in the tropics by the fermentation of cellulose. After discussing the souring of cream, ripening of cheese and other industrial processes in which bacteria play a part, the chairman referred at some length to tropical fermentations that he had himself investigated. As these are less known than the home industries it may be of interest to give greater detail.

Coffee Fermentation.—The fermentation of coffee has not the profound influence on the composition and therefore on the flavour and aroma of the berry that the fermentation of cocoa effects, but it has some influence on the flavour of the berry. In any case it is essential to carry out a brief process of fermentation (lasting from 24–36 hours) in order that the pulp adhering to the outer skin may be loosened and dissolved. It takes the form of a mild alcoholic fermentation in which "wild" yeasts and true yeasts play a part. The berries are then washed in running water and dried. After this treatment the parchment skin is brittle enough to be removed by breaking with an edge-runner and winnowing. It will be readily understood that the hard, dense structure of the berries prevents the products of fermentation from penetrating readily, but the alcoholic fermentation is undoubtedly accompanied by some softening of the astringency and improvement in the subsequent aroma of the roasted berry.

Cocoa Fermentation.—The way in which cocoa beans are cured varies greatly in different countries,

but only the crudest cocoa is dried without being subjected to a more or less prolonged fermentation. The following notes are based on a close observation of many hundreds of fermentations in the West Indies:—

The cocoa pods are cut open, the contents scooped out and conveyed into large tanks or boxes, where the sweet, viscous pulp, in which the beans are embedded, ferments and forms a thin alcoholic and acid liquor, which largely drains away.

The first runnings from a fermenting box in Jamaica, taken 15 hours after the pods were broken, contained 4.9 per cent. of alcohol and 0.8 per cent. of acids calculated as acetic acid (chiefly tartaric and acetic). Part of this liquor penetrates into the beans, which are thus saturated with the products of fermentation, but the shell membrane is fine enough to prevent the micro-organisms from percolating to the kernels.

The beans and adherent pulp, which are commonly at a temperature of 26–28° C. when placed in the fermenting box, rapidly become warmer. During the first twenty-four hours the temperature rises to 35° C. or 40° C., varying with the exact position in the box. Within forty-eight hours it rises to 40–45° C., and if the fermentation is continued for five or six days the temperature will be found to rise to a maximum of 45–50° C. Higher temperatures are occasionally noted, but they rarely exceed 53° C. If the fermentation is continued for the exceptionally long period of ten to eleven days, a custom practised on certain Trinidad estates, the temperature will fall slightly towards the close. It is customary to transfer the contents of the fermenting boxes from one box (or cement tank) to another every two or three days. Some form of false bottom is provided, and the cover is loose, so that partial aeration goes on throughout the process. The quantity of cocoa dealt with in each box represents, on an average, the contents of 8000 to 16,000 pods, or 12–24 cwt. of wet material. The outside of the bean changes from white or pale pink to rich brown; characteristic odours are evolved, and a vigorous fermentation takes place. The stages of this fermentation may be distinguished thus:—

First, a large growth of *Saccharomyces apiculatus*, together with small quantities of *Saccharomyces anomalus*, etc., doubtless derived from the surface of the pod husks. This stage lasts about twelve hours.

Secondly, as in spontaneous wine-fermentation, an enormous development of true *Saccharomyces* occurs, exhibiting typical oval and round cells. If the temperature rises normally, no formation of new cells is noted after the first forty-eight hours. The alcohol produced soon arrests the growth of *Sacch. apiculatus* and the “wild” yeasts. A quantity of alcoholic liquor drains away.

The third stage of fermentation is characterised by a very large growth of acetic-acid bacteria, a great number being carried to the fermenting boxes by swarms of the “vinegar fly” (*Drosophila*). The drainings now consist of a dilute vinegar. The complete mixing of the mass every second or third day ensures the presence of these organisms in every part of the fermenting mass. If the temperature does not rise above 50° C., the acetic bacteria continue to grow during the remainder of the fermentation.

A fourth stage is reached if the fermentation is prolonged beyond eight days, when a growth of spore-bearing bacilli of the *Bacillus subtilis* type becomes evident.

In addition to these successive fermentations it will be found that when the cocoa is turned out from the fermenting boxes and dried slowly in the sun, as is often the case, a modified fermentation takes place at night, so long as the beans are sufficiently

moist, and large colonies of wild yeast and bacteria become visible on the surface of the beans.

With the advance of fermentation the change of odour is marked; the sweet, fruity, and alcoholic odour of the early stage changes to a strongly alcoholic, and this to an ethereal odour suggesting ethyl acetate. Later a strong acetic odour supervenes, but this is always accompanied by fruity and ethereal components. Finally, if the fermentation is prolonged and putrefactive organisms predominate an odour resembling that of high game is evolved.

A paper on “The Loss of Ammonia by Oxidation in By-product Processes” was contributed by Messrs. H. D. Greenwood and H. J. Hodsman.

In the carbonisation of coal less than one-fifth of the nitrogen content is recovered as ammonia, and a similar proportion is obtained as free nitrogen; the loss of ammonia is usually ascribed to dissociation, though recently the view has been urged that oxidation by oxygen in the gas or indrawn air is a more serious factor. Experimental evidence is adduced to show that when coal gas containing ammonia and oxygen is heated under conditions comparable with those of practice, the oxygen reacts preferentially with the constituents of the coal gas. Even at 600° C., the whole of the oxygen can be removed without destroying any of the ammonia. Under similar conditions with air in place of coal gas the ammonia is vigorously oxidised. Even when oxygen is present in the coal gas, the ammonia seems to be destroyed by dissociation. The deleterious effect of indrawn air may be due to consequent heating of the gas which would conduce to dissociation. The contention that the presence of water vapour inhibits the oxidation of ammonia in air is confirmed and explained.

Dr. L. L. Lloyd has been elected chairman of the Section for 1922-23, Mr. John Evans vice-chairman, and Messrs. S. H. Davies, J. A. Reddie and A. R. Tankard members of the committee.

MEETINGS OF OTHER SOCIETIES.

THE IRON AND STEEL INSTITUTE.

The annual meeting of the Iron and Steel Institute, held in the buildings of the Institution of Civil Engineers on May 4 and 5, was an exceptionally interesting one. The new president, Mr. Francis Samuelson, devoted his address to a consideration of some important practical questions of the future, regarded from the blast-furnaceman's point of view, including that of the future of our ore supplies. The Bessemer Medal was awarded to Prof. K. Honda, of Sendai, for his important researches on the constitution of steels, especially in relation to their magnetic properties.

Of the numerous papers, that which received most discussion was a review of British Siemens furnace practice, by Mr. F. Clements. Following a paper of some years ago by the same author, dealing with blast-furnace practice, Mr. Clements has fully analysed a heat conducted in a furnace under his own control, giving complete chemical and thermal balance-sheets, with records of temperature and other data throughout the heat, and has supplemented this by a long series of tables, giving comparative data concerning furnaces in different parts of this country, tables which will be invaluable to all who have to consider furnace design. The paper concludes with a set of designs for a new Siemens furnace of large capacity, based on the experience here summarised, and expected to give a higher

efficiency than any existing furnace. So much interest was shown in this paper that it was decided to hold an adjourned discussion, which will probably take place in Sheffield. Two other technical papers were contributed, one by Col. D. Selby-Bigge on power production, and one, which proved to be controversial, on blast-furnace filling, by Mr. D. E. Roberts, differences of opinion as to the respective merits of skip and bucket filling being revealed in the discussion.

The purely scientific papers, which were numerous but not lengthy, had to be discussed very briefly. The most remarkable of these was Col. N. T. Belaiew's study of the inner structure of the pearlite grain. An ingenious geometrical method has enabled the author to determine the actual distance between the cementite lamellae in a given section of steel, it being found that this distance is practically constant for a given heat-treatment, so that it may become a valuable means of controlling annealing, etc. This paper was illustrated by photomicrographs of remarkable beauty, which were seen to even greater advantage in the enlargements handed round at the meeting. Very pretty structures were also obtained by Prof. H. C. H. Carpenter and Miss C. F. Elam in the action of oxidising gases on iron under rather peculiar conditions, parallel growths which appear to consist of oxide being formed on the surface of the crystal grains. Mr. A. F. Hallimond suggested a very interesting explanation of the formation of pearlite, troostite and martensite in steel under varying conditions of undercooling, based on the theory of undercooling due to Miers. The facts are harmonised in a quite remarkable way by the application of this principle. Mr. J. H. Whiteley's study of the conditions of formation of granular and lamellar pearlite should also be read in this connexion. Other papers dealt with decarburisation by hydrogen, the influence of oxides on case-hardening, and with certain details of the iron-carbon diagram, two papers on the latter question being contributed by Prof. Honda.

ROYAL SOCIETY OF ARTS.

A paper on "The Production of Titanium Oxide and its Use as a Paint Material" was read by Mr. Noel Heaton at a meeting held on May 3.

The production of titanium dioxide for use as a pigment was investigated simultaneously some ten years ago by Messrs. Rossi and Barton in the United States and by Jensen and Farup in Norway. Operations were started on an industrial scale in both countries independently, but since 1918 the two companies have worked in collaboration.

In Norway the titanium oxide is extracted from a variety of ilmenite found near Egersund, of which 30 million tons is estimated to be available. The ore is freed from associated minerals, and the concentrate, containing 47.5 per cent. of titanium oxide, is reduced to fine powder and mixed to a paste with concentrated sulphuric acid. On heating this mixture the mineral is entirely decomposed and converted into a "coagulated mass" containing soluble sulphates of iron and titanium. This is extracted with water, and on heating the reduced solution nearly to boiling point the whole of the titanium is precipitated as titanic acid. This is washed by decantation until free from iron, and allowed to settle. After removing as much water as possible the resulting pulp is passed into a rotary furnace, where, in one operation, it is dried and calcined at a high temperature. The calcined product is finally pulverised and separated as impalpable powder by air-flotation.

In practice barium sulphate is mixed with the solution before precipitation, and a small amount of calcium phosphate and barium carbonate added to

the pulp before calcination. These additions are found to facilitate control of the calcination and ensure a more uniform product. In the calcination process the titanic acid is converted into cryptocrystalline titanium dioxide, which enters into physical combination with the barium sulphate. This composite product is known as Titanium White to distinguish it from the pure oxide, and is marketed in two grades, "extra" and "standard," the latter consisting approximately of 25 per cent. of titanium oxide and 75 per cent. barium sulphate.

These titanium pigments are eminently suitable for the preparation of all classes of paint on account of their chemical stability and inertness. They are non-toxic, and are quite unaffected by any of the destructive agencies, *e.g.*, sulphuric acid and hydrogen sulphide, to which paint is likely to be exposed.

One would, therefore, expect great durability from titanium paints, and this point has been investigated on a most elaborate scale by exposure tests which have been in operation in Norway since 1918. The general result of these tests is that paints made with titanium white have shown no tendency to crack or peel, but have worn down evenly, leaving the surface in an excellent condition for repainting. The most durable paint of all proved to be that prepared from a combination of titanium white with a proportion of zinc oxide.

The principal physical properties of titanium white are given as:—

Refractive index: Extra 2.60, Standard 2.30.

Specific gravity: Extra 4.00, Standard 4.30.

Average diameter of particles—one micron.

On account of this peculiar combination of properties titanium whites possess greater opacity and also greater spreading power than any other white pigments. The plant used for titanium white is also employed to produce amorphous titanium dioxide in large quantities. The percentage composition of this is:— TiO_2 93.00, combined water 3.25, SO_2 2.75, SiO_2 0.85, Fe_2O_3 0.13.

THE ROYAL SOCIETY.

At the meeting held on May 4, Sir C. Sherrington presiding, a paper entitled "Observations on the Distribution of Fat-soluble Vitamins in Marine Animals and Plants" was read by Mr. J. Hjort.

The author has found that the periodic changes in the size and quality of fish are associated with changes in the content of fat. Changes in quality of cod are most easily demonstrated by inspection of the size of the liver, one-half of which consists of cod-liver oil. Livers of full-grown cod, caught when feeding in summer, were found to be three times as heavy as those of cod taken in winter during spawning time. The seasonal variations in quality do not coincide either with temperature variations or with the availability of animal food, and it was thought, therefore, that they might depend on variations in the chemical qualities of the food. The distribution of fat-soluble vitamin was accordingly studied in green algae, diatom plankton, shrimp and prawns, and the hard roes of herring and cod. It was found that these materials, fed fresh or dried, had a very marked effect in restarting and maintaining the growth of rats that had stopped growing through being fed on a diet free from fat-soluble vitamin. Fats extracted from algae and from roes had a similar effect. The results strongly suggest that the fat of diatoms also contains vitamin.

Prof. W. Bulloch communicated a paper by W. Cramer, A. H. Drew, and J. C. Mottram on "Blood-Platelets; their Behaviour in Vitamin-A Deficiency and after 'Radiation,' and their Relation to Bacterial Infections," in which it was shown that absence of fat-soluble vitamin from the

diet of the rat always caused a progressive diminution in the number of blood-platelets, and that this lesion (thrombopenia) was characteristic of the deficiency of vitamin A, just as lymphopenia was characteristic of the lack of vitamin B. Complete recovery from thrombopenia occurred when vitamin A was added to the diet, provided the deficiency had not lasted too long. Exposure to radium emanations produced not only lymphopenia, but also, with sufficiently large doses, thrombopenia. Recovery was rapid, however, if treatment was discontinued and the dose had not been too large.

ROYAL PHOTOGRAPHIC SOCIETY.

On May 9, in the rooms of the Royal Society of Arts, the third Hurter and Driffield Biennial Memorial Lecture was delivered by Prof. The Svedberg on "The Interpretation of Light Sensitivity in Photography." The lecture was probably the most important contribution to the subject that has been made for many years. At its conclusion, Mr. W. L. F. Wastell, president of the Society, presented the lecturer with the Hurter and Driffield Memorial Medal.

Prof. Svedberg reminded his audience that the lecture was given to commemorate the pioneer work of Messrs. Hurter and Driffield on the laws governing the action of light on the photographic plate. These laws were still incompletely understood, and their elucidation was the most important problem before photographic investigators to-day.

The sensitivity of a substance might be defined as the number of gram molecules decomposed by unit light energy. According to Einstein, this energy must always be equal to $Nh\nu$, where N and h are Avogadro's and Planck's constants, and ν the frequency of the light. In general terms, a molecule required exactly one light quantum for its decomposition. Experimentally it had been found that though many photochemical reactions follow the law, more do not. The quantity of material decomposed was often dependent more on secondary reactions than on the primary light effect. In the decomposition of ammonia by ultra-violet light, secondary reactions permitted only a fifth of the theoretical decomposition to occur. In the union of hydrogen and chlorine, on the other hand, the fission of one chlorine molecule caused the formation of hundreds of hydrogen-chloride molecules, owing to the multiplying effect of side reactions. Silver salts in photographic emulsions had a low primary efficiency, but the application of developer produced secondary changes of extraordinary magnitude. The primary sensitivity was a property of the molecules and could not be altered; to increase the speed of emulsions, they must try to improve the multiplying mechanism.

At the outset they must distinguish between plate sensitiveness, grain sensitiveness, and sensitiveness of the grain material. The last-mentioned quantity was of fundamental importance, but it must be arrived at by the study of grain sensitiveness. By exposing single-layer emulsions and photographing them in red light, before and after development, the lecturer had been able to decide the vexed question as to whether adjacent grains were affected by, or contributed to, the development of an affected grain. He had shown there was no effect. Examination of partially developed and fixed-out emulsions revealed one or more development centres in some of the grains. An ingenious method of superposition had enabled the nuclei and their parent grains to be identified. Statistical measurements showed that the larger the grains the greater the probable sensitiveness, but that, on occasion, a small grain might be more

active than a large. This suggested the existence of centres of activity which might be located in any grain. Further statistical examination revealed that the grain centres were distributed purely according to the laws of chance, and that the probability of any number of centres occurring in any grain could be predicted by an equation. These centres might exist throughout the volume of the grain or merely on the surface. To determine this, emulsions were exposed to X-rays, so that the grains might be affected equally throughout their mass, after which they were partially developed, and fixed. By a microprojection process, the images of many affected grains could be superimposed, and points corresponding to centres of activity pricked on to a card. A circle was drawn enclosing the points, and another of half the radius was drawn concentrically. The numbers of points in the inner circle and the outer zone were found to be in the ratio 1:6:6. It could be shown mathematically that if the active centres were distributed uniformly through the grain volume, the ratio of the points in the projected circles would be as 1:1:9; if on the surface, as 1:6:5, a figure which was in good agreement with the experimentally determined ratio, 1:6:6. This afforded excellent proof that the centres were located on the surface. The sensitivity of the silver-halide material might now be defined as the average number of centres per square centimeter of grain surface. Thus, the important results had been arrived at, that the development centres occurred at random among the grains, and that they existed on the surface. Whether the haphazard distribution was a characteristic of the emulsion, or due to the reception of discrete quanta emitted by the light source, the lecturer was not prepared to say. That was a matter which must be left to future investigation.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

At the meeting held on May 9 at the Royal Society of Arts, Prof. J. S. S. Brame presiding, Mr. E. H. Cunningham Craig read a paper on "Kukkersite, the Oilshale of Esthonia."

The name is derived from Kukkers, the locality where the deposit was first exploited, but the material is an ordinary oil-shale though unusually rich. The deposit is approximately 36 miles long and 7 miles wide, containing probably two million tons of oil shale per square mile at a depth of six feet. The present production is about 700 tons per day and is used partly as fuel and partly for cement-manufacture. In distillation 70 to 80 gallons of oil per ton are obtained. The nitrogen yield is low and the sulphur content 1.6 per cent.

The shale is fine-grained and gray to green in colour; it is crowded with fossil remains (calcium carbonate) and analysis indicates that it is essentially a fuller's earth and was probably deposited slowly on a shallow shore almost entirely free from muddy sediment; associated with it are comminuted shell fragments and layers of fine-grained littoral limestone. The general geological structure is extremely simple, for there are neither igneous intrusions nor carbonaceous deposits, and no indications of local terrestrial disturbances.

H. von Winkler has discussed the problem of the origin of these deposits and considers the organic component to be "sapropel," a structureless jelly of algal origin. Mr. Craig thought that such a theory was not compatible with the richness of the deposit (70—80 galls. of oil per ton) or with the low sulphur content, and stated his conviction that no other material but colloidal absorbent inorganic material laden with inspissated petroleum could

give the yield of oil which is afforded by such a rich oil-shale.

Search for confirmatory evidence of the existence of petroleum in this district has demonstrated the existence of gas (including a mud volcano), of a show of oil, and of veins of manjak. The level nature of the strata precludes the concentration of petroleum in localities, but the author considers that the general evidence is overwhelmingly in favour of the petroleum theory of the origin of oil-shale.

THE ROYAL INSTITUTION.

The Friday Evening Discourse on May 12 was delivered by Dr. H. H. Dale on "The Search for Specific Remedies."

The idea of seeking for each disease a special remedy to cure it directly is a very old one, and the empirical methods of the pre-scientific era were undoubtedly successful in many instances. The idea of modern therapy is, however, to find for each disease a drug that will inflict maximum damage upon the invading organism and minimum harm on the host. Of late years the chemist, or chemotherapist, has attacked this problem and found a number of substances which exert a strongly toxic action on a particular parasite and a very weak toxic action upon the organs and tissues of the patient. Dr. P. Ehrlich and his school did notable work in this direction, but the hypothesis underlying their work, viz., that the specific remedy is a kind of "sighted rifle," capable of hitting the parasite but missing the host, is now open to considerable doubt. It has been found, for example, that Salvarsan does not directly kill the spirochaete of syphilis unless this is inside the human body; and Dale and Dobell have shown that whereas emetine and the other chief alkaloids in ipecacuanha have very little action on the germ of amoeboid dysentery *in vitro*, they have a strong action upon it *in vivo*. In fact, there is now much evidence to show that the living tissues of the organism play an essential part in the curative process. The nature of the co-operation between the remedy and the organism is a field of investigation which is likely to yield extremely important results.

A remarkable synthetic drug which destroys the trypanosomes in the blood of sufferers from sleeping sickness has been discovered by Fr. Bayer & Co., and marketed under the name of "Bayer 205." It is not a dye, and its constitution has been kept secret, though it is probably similar to that of Trypan Blue. A man suffering from sleeping sickness in an acute form was recently sent from the Liverpool School of Tropical Medicine to Hamburg for treatment with "Bayer 205." He was given two injections, and a fortnight later was enjoying a walking tour in the Black Forest. He has returned to Africa completely cured. A supply of the preparation is now in use in this country, and, with the sanction of the Colonial Office, a commission of German medical men has gone to Rhodesia to submit the remedy to a searching test. Apparently its only disadvantage is that it irritates and damages the kidneys. It is without action on trypanosomes *in vitro*.

INSTITUTION OF ELECTRICAL ENGINEERS.

The following are the new officers and members of Council of the Institution of Electrical Engineers for the session 1922-23:—President: Mr. F. Gill; Vice-presidents: Dr. W. H. Eccles and Mr. A. A. Campbell Swinton; Council: Major K. Edgcumbe and Messrs. J. W. Beauchamp, R. A. Chattock, F. W. Cawter, D. N. Dunlop, A. F. Harmer, and W. R. Rawlings.

CORRESPONDENCE.

TOXICITY OF CERTAIN COAL-TAR CONSTITUENTS.

SIR,—The toxic action of certain constituents of coal-tar on fish life has once again been brought into prominence by the interesting paper, "The Determination of Tar Acids and Tar Bases in Drainage and Mud," by Dr. J. J. Fox and A. J. H. Gauge, read before the London Section on May 1 last.

The object of this letter is to draw attention to the apparent similarity of cause which on the one hand is responsible for the poisoning of fish and on the other results in the skin disease known as "pitch cancer" or *epithelioma* to which workers in pitch are liable. In both cases acridine has been mentioned as being the dangerous substance, and in connexion with pitch cancer it appears to have been definitely established that the mischievous agent occurs in the heavy oils of tar; also that it is soluble in water.* It was also discovered that the dangerous principle occurs in the pitch obtained from water-gas tar, in Mexican solid bitumen and in the pitch derived from it, but not in blast-furnace pitch. The observation last mentioned accords with the common experience that workers in blast-furnace pitch do not contract *epithelioma*.

It is well known that the tar from blast furnaces contains a large amount of cresols and higher phenolic substances, but I am unable to discover if it has been examined for acridine. Possibly experiments on the action of blast-furnace tar on fish life might be interesting or even useful. Should this tar be found to be innocuous to fish, the small production, about 200,000 tons of crude tar per annum, would restrict its application to roads in the neighbourhood of fish ponds and streams.—I am, Sir, etc.,

London,

May 5, 1922.

W. KIRAY.

CARBON TETRACHLORIDE AND METHYL BROMIDE IN FIRE-EXTINGUISHERS.

SIR,—Carbon-tetrachloride fire-extinguishers and the dangerous fumes which result from their use were referred to in your issue of April 29 in an article headed "Respirators for Firemen," by Dr. L. A. Levy. This article should be of great interest to manufacturers and users of carbon-tetrachloride fire-extinguishers. The dangerous nature of carbon-tetrachloride fumes has been repeatedly referred to in official reports and technical papers during the last three or four years, and there is no reason why this substance should be used any longer for this purpose. Much better results can be obtained from a liquid which does not give rise to chlorine and phosgene. The base of this liquid is methyl bromide, which has a boiling point of 4.5° C., against the boiling point of 76° C. of carbon tetrachloride, and thus has naturally its own propelling power at normal temperatures.

Exhaustive tests have shown that 10 parts of petrol flash when thoroughly mixed with 15 parts of carbon tetrachloride, whilst there is no flash when 10 parts of petrol are mixed with only 2 parts of methyl bromide. In these tests, a lighted taper held over the mixture containing methyl bromide was always extinguished, but this did not occur when it was applied to the mixtures containing carbon tetrachloride. Further, the freezing point of methyl bromide being -84° C. against that of carbon tetrachloride, -23° C., it is far more serviceable at low temperatures. At 20° C. the spray

* "The Problem of the Gasworks Pitch Industries and Cancer," by Dr. H. C. Ross and Dr. J. W. Cropper.

from a methyl-bromide container will travel 15 feet. From a vessel containing carbon tetrachloride it will not travel at all. Mechanical propulsion is not at all necessary with methyl bromide.

The above facts have been known for a considerable period, and I venture to think it is about time that fire-extinguishers were improved from the stage of the ancient cross-bow to that of the modern fire-arm.—I am, Sir, etc.,

London.

ALBERT HENNING.

May 12, 1922.

NEWS AND NOTES.

SOUTH AFRICA.

New Fertiliser Works at Somerset West.—In the March number of the *South African Journal of Industries*, Prof. I. de V. Malherbe of the University of Stellenbosch describes the new fertiliser works which has been erected by the De Beers Company at Somerset West. The writer comments on the fact that hitherto the gold- and diamond-mining interests have taken little or no action to foster agriculture, which must eventually be the chief industry of South Africa.

We understand that this new venture is the outcome of the policy of our Colonial Office, arising out of the experience of the war, and the object of which is to bring about more stable conditions by making agriculture the backbone of the country. It is an accepted fact that greater stability is more likely to exist in a country possessing a large agricultural community than in a country which is mainly dependent on mining and manufacturing; and the De Beers Co. is therefore to be congratulated on its public spirit. Some of the best brains in the Department of Explosives Supply of the Ministry of Munitions during the war have, we understand, been employed on the work of organising and erecting these works, which are said to be capable of producing 100,000 tons of fertiliser per annum, and the plant would appear to be laid out on the most up-to-date lines. The new factory is apparently situated near the existing sulphuric-acid plant of the Cape Explosives' Works and the acid is conveyed through pipes over the $1\frac{1}{2}$ miles of intervening country.

From Dr. Malherbe's description the superphosphate plant is apparently constructed on the lines of the modern American factories, where the handling of large quantities of material in bulk is thoroughly understood. We have the same large dens, each holding 300 tons of "super," into which the mixture of acid and phosphate is charged from a platform which forms the top of the den and which can be moved from one den to another. The superphosphate is dug out by means of an overhead "grab" crane and conveyed to the storage shed by the same overhead crane which travels the whole length of the huge building, 700 ft. long by 75 ft. wide and 80 ft. high.

There is no doubt that American methods involve an absolute minimum of labour, but in America it is not necessary to obtain a maximum of water-soluble phosphate in superphosphate, whereas in South Africa the agricultural authorities insist on a guarantee of solubility in water. We believe that when the "super" is mixed in these large dens and dug out in the rough, the maximum solubility is not obtained, but no doubt this difficulty can be overcome by introducing slight variations in the American methods.

One of the chief difficulties in the fertiliser trade in any country is that of transport, and it is to be

hoped that the South African Government will foster cheap railway rates so as to encourage a large increase in the use of fertilisers.

The factory at Somerset West has a capacity greater than the present importations into South Africa and is capable of extension when the demand increases.

UNITED STATES.

Spring Meeting of the American Chemical Society.—Although the attendance of members at the 63rd meeting of the American Chemical Society, held in Birmingham, Alabama, from April 3 to 7, was somewhat below standard, the throughput of work was fully up to the average. The number of papers read was once again little short of stupendous. In addition to ten addresses and papers at the General Meeting and one at the Public Meeting, no fewer than 226 papers were presented to the various Divisions and Sections. We had hoped to reproduce the titles of these papers, together with a few abstracts, which have been supplied by the enterprising A.C.S. News Service, but considerations of economy have frustrated this intention.

At the Council Meeting a letter was read from Mr. Francis P. Garvan stating that the Chemical Foundation would provide a sum up to \$25,000 during 1922 to cover the cost of printing the Formula Index and other chemical literature which, owing to lack of funds, the Council had reluctantly decided to postpone. It was also announced that the publication of the first two monographs issued for the Society by the American Catalog Co. had been a financial success. A resolution was passed urging publishers to date their books according to the time they are written or revised rather than to the time when they are printed; and it was decided, from January, 1923, to omit the first three words of the title, *The Journal of Industrial and Engineering Chemistry*. The preferment of the Cellulose and Petroleum Sections to the status of Divisions was sanctioned, and it was resolved that in future a Section must pass through a probationary period of three years before it was eligible to rank as a Division. Another resolution was to the effect that at future meetings the names of those who had contributed funds to the advancement of chemical research should be publicly announced. Finally, by a narrow majority the Council decided to favour the establishment of an employment agency for chemists, and, by an overwhelming majority, that such agency should not be conducted by the Society.

The autumn meeting this year will be held in Pittsburg, and the spring meeting next year in New Haven.

Chromite in 1920.—The effect of the war was still to be seen in the large stock of chromite, 41,500 long tons, in hand at the opening of 1920. Of the quantity sold during 1920, viz., 2502 t., 57 per cent. came from California, where 17 of the 19 mines are situated, Oregon and Wyoming possessing one mine each. Imports were heavier than in any preceding year and amounted to 150,275 t. (65,180 t. in 1913); they were derived chiefly from New Caledonia, 56,682 t., South Africa, 39,400 t., Asiatic Turkey, 12,760 t., Portuguese Africa, 11,000 t., and Canada, 8491 t. The average value per ton was \$12.79. No exports of chromite were recorded, and the apparent consumption was 152,777 t., an increase of 130 per cent. over 1919 and of 133 per cent. over 1913. The War Industries Board estimates that 52 per cent. of the chromite used in 1918 was for making ferrochrome, 31 per cent. for chemicals, and 17 per cent. for refractories. The world's production of chromite in 1920 is estimated to have been 190,000 metric tons, distributed as follows:—New Caledonia 60,000 t.; Rhodesia 54,674 t.; Asiatic Turkey 25,000 t.; Canada 9525 t.; Brazil 3451 t.—(*U.S. Geol. Surv., Aug. 17, 1921.*)

FRANCE.

Industrial Notes.—Chemical Industry.—The utilisation of the powder-factory established at Toulouse during the war has been much debated, but it is now practically certain that the power-plant of the factory, comprising two 3000-kw. units and two 2000 kw. units, will be leased to a private company. Parliamentary sanction is awaited for the scheme under which the gun-cotton section of the factory, situated at Braqueville, would be adapted for the production of synthetic ammonia by the Haber process. The engineers of the Badische factory have worked out the details of the scheme, which would find employment for some 2000 workmen, and entail working day and night. Power would be supplied by the company, which proposes to take over the central power-plant of the factory. It is estimated that two years after commencing work the factory would be able to produce 100 metric tons of combined nitrogen (? per day). However, the owners of the Claude process are determined that they shall not be outdistanced by the Haber interests, and M. Claude is now devoting close attention to the industrial production of hydrogen at the works of the Société de la Grande Paroisse. The use of coke-oven gas was at first contemplated, but the separation of the hydrogen was found to present too great difficulties. M. Claude therefore uses water gas instead, and with a small apparatus 3 metres high can produce 15,000 cb. m. of hydrogen a day, a volume sufficient for making about 20 metric tons of ammonium sulphate.

The "coefficient of increase" applied to the import duties on dyestuffs will probably be raised to 6, but this increase will not apply to dyes not yet produced in France.

Lignite.—The forecast of the United States Geological Survey, that the petroleum resources of that country will be exhausted in about 16 years, creates a very serious outlook for France, which depends upon the annual importation of 600,000 metric tons of liquid fuel, worth about one billion francs. Production of benzol in coke-oven and gas works cannot be raised to more than 70,000 t. per annum, which is five times the present output, and it is urged that France, following the example of Germany and Czechoslovakia, should adopt the low-temperature carbonisation of lignite, of which there are reserves estimated at 4000 million t. The lignites of the Rhone valley contain but 15–20 per cent. of moisture and have a calorific value of 6235; on carbonisation, it is estimated that one ton of lignite would yield 10–15 kg. of petrol and 50–60 kg. of heavy oils, which could be "cracked" to increase the supply of lighter oils.

BRITISH INDIA.

Forecast of the Sesamum Crop.—In a supplement to the final general memorandum on the sesamum crop, the estimated area under the crop and the yield for the 1921–22 season are given as 4,611,000 acres and 515,000 tons, respectively, which compare with 4,432,000 acres and 382,000 t. in the previous season. This estimate does not include sesamum grown on an area of 1,209,000 acres, estimated to produce 134,000 t.—(*Ind. Tr. J.*, Apr. 27, 1922.)

JAPAN.

The Acetic-Acid Industry.—The total capacity of the Japanese acetic-acid industry is 8250 tons of acetic acid per annum, but the present output is less than half this quantity owing to trade depression and foreign competition. Acetate of lime can be imported from the United States and Canada for 6 yen per 100 lb., duty paid, whereas the cost of production in Japan amounts to 9.60 yen (yen = 2s. 0½d. at par, now about 2s. 1½d.). The Nippon Acetic Acid Manufacturing Co. has therefore

petitioned the Government to increase the duty on acetate of lime from 0.41 yen to 1.50 yen per 132.3 lb., but the Osaka Commercial Guilds' Federation opposes this and advocates removal of the import duty on the ground that it would enable the industry to lower prices and increase the output on a competitive basis. Further, even were a protective duty imposed it is claimed that the output could not be increased to more than about 2230 t., compared with a demand for over 20,500 t. There is a large market for acetic acid in the South Seas and the demand from the dyeing, dyestuffs, paint, celluloid and other industries is steadily increasing.—(*Ch. of Comm. J.*, May 5, 1922.)

CANADA.

Industrial Notes.—The furnaces in the glass works of Pilkington Bros. at Thorold, Ont., are being rebuilt and extensive enlargements made in view of the revival of the building trade in Canada.

The official reports of the American Cyanamid Co., which has a cyanamide plant at Niagara, Ont., indicate that these works have lately been operating at approximately 30 per cent. capacity.

The International Nickel Co., having closed its works at Bayonne, N.J., has transferred a portion of the equipment to a new plant at Huntington, West Virginia, and to Port Colborne, Ontario. The Huntington plant will roll nickel and monel metal.

The Canadian collieries, Granby and Western Fuel, have been conducting experiments on oil-floatation with a view to improving the condition of their products and enhancing their market values; also of recovering coal which at present goes to the waste dumps.

The Pacific Starch Products, Ltd., has been incorporated in British Columbia to manufacture starch, potato flour, glucose, sago, tapioca and dextrins. The factory is being erected at South Westminster and the capacity of the plant will be 6 short tons per day.

The new tannery now being erected at East Calgary, Alberta, is expected to be in operation during June. Sir James Outram is the head of the company. The Nance vacuum process will be employed and the machinery has been purchased in England. Large quantities of hides, which at present are quite unsaleable, are available in the district.

The Dominion Alloy Steel Corporation, Ltd., incorporated under the Dominion Companies Act with an authorised capital of \$15,000,000, is about to erect a plant at Sarnia, Ont., and to produce annually 50,000 tons of alloy and high-carbon steels for the motor and other industries. The new company will have associated with it men who are familiar with the steel industry and the requirements of special consumers, and the directors include both Canadians and Americans who are interested in the manufacture and uses of steel.

The Canadian Manufacturers' Association has been investigating the asbestos industries of Quebec in the light of the new Fordney tariff. Quebec exports 90 per cent. of its raw asbestos, valued last year at \$7,690,165 (145,283 tons), to the United States, but the exports of manufactured asbestos were worth only \$64,473. It has been suggested to impose a special export tax upon raw asbestos shipped to the U.S.A. in view of the fact that the Fordney tariff provides an *ad valorem* duty on manufactured asbestos of from 54 to 80 per cent., according to the classification. A recent announcement of Premier Taschereau (Quebec) on the exportation of pulp wood indicates that he is decidedly opposed to the exportation of raw materials to the United States to be manufactured there into finished products.

GENERAL.

"Journal of Scientific Instruments."—Hitherto there has been available no English journal devoted entirely to the subject of scientific instruments. In Germany there is a number of such journals, and the attempt now being made to fill this gap in English scientific literature will, it is hoped, meet with support and success. A preliminary number of a "Journal of Scientific Instruments," produced by the Institute of Physics with the co-operation of the National Physical Laboratory (printing costs being defrayed by the Advisory Council for Scientific and Industrial Research) is now being distributed gratis with a view to ascertaining what support may be anticipated. In a foreword to the preliminary number, Sir J. J. Thomson comments upon the value of such a journal in all branches of science and industry, and remarks that a circulation of about 3000 would render the journal self-supporting. The contemplated journal would probably consist of 32 pages and be published monthly at 2s. 6d. per issue.

In addition to the foreword referred to the preliminary number contains, among other items, a suggestive article by Prof. A. V. Hill on "Instruments and Apparatus in Relation to Progress in Physiology," a description of "The New Fundamental Bench Mark of the Ordnance Survey" by Sir Charles Close, details of "Two Machines for Rapidly Weighing Loads of a few Milligrammes" by the Research Staff of the General Electric Co., Ltd., London (*cf.* J., 1922, 96 n), and particulars of a process for "The Production of Uniform Cylinders of Small Diameter" by G. A. Tomlinson. A list is given of articles which, it is contemplated, will appear in future numbers of the journal. No steps have yet been taken to invite manufacturers generally to contribute articles, as it is expected that offers of this nature will be forthcoming; such articles would constitute an important feature of the journal. Copies of the preliminary number may be obtained on application to the Secretary of the Institute of Physics, 10, Essex Street, London, W.C. 2., and 6d. should be enclosed to cover postage.

New Possibilities for the Utilisation of Zirconia.—Writing in the *Chemiker-Zeitung* (No. 50, 1922, p. 380), Dr. R. E. Kirchner explains why attempts to utilise zirconia for industrial purposes have so far met with little success. The purposes for which its use has been proposed are in most cases already satisfied by a much cheaper, though perhaps less efficient article, or are of such a nature that they would create little demand. The demand for membranes for gramophone recorders, for instance, is extremely small, and the fact that a glass prepared from pure silica, titania and zirconia gives an ideal membrane will not go far towards establishing a zirconia industry. The use of zirconia as a substitute for stannic oxide in the manufacture of enamels offers greater scope, if zirconium borate can be produced more cheaply than stannic oxide. More important developments, providing ample scope for the discoverer, may be looked for in other directions. Zirconium steel is extraordinarily hard; and plates of zirconium-nickel steel, which are twice as resistant to shot as those of chromium steel, can be used for armour-plate. Zirconium carbide is hard enough to cut quartz and might well replace the diamond for glass-cutting. As a refractory zirconia is unrivalled. Zirconia crucibles are still too dear, but a method might be found for lining clay or bauxite crucibles with a layer of zirconia. As a covering for electric-arc furnaces zirconia is an ideal material. The discovery of a suitable binding material for zirconia has not yet been made, nor has a satisfactory and economical method been found for obtaining it free from iron. There is enough material in South

America to ensure a plentiful supply of zirconia for centuries to come, and a reduction in price—the present cost is \$150 per ton of 80 per cent. ZrO_2 —cannot be long delayed.

The World's Production of Cane and Beet Sugar.—Estimates published by Messrs. Willet and Gray place the world's total production of cane and beet sugar for the year 1921-22 at 16,582,560 long tons, a decrease of only 8126 t. compared with the preceding crop. Production of cane sugar has declined from 11,916,069 t. (actual yield) to 11,607,060 t., but the beet-sugar crop has increased from 4,674,617 t. to 4,975,500 t.—(*Ind. Tr. J.*, Apr. 20, 1922.)

Industrial Notes from Poland.—*Metal Production.*—The output of crude iron in Poland improved from 42,200 metric tons in 1920 to 60,000 t. in 1921, but these figures represent only 10 and 14 per cent. respectively of the production in 1913. In 1921 the part of the country formerly known as Congress Poland produced 2400 t. and Galicia 2600 t. of zinc, and the output of lead, mainly from Galicia, was 1010 t. In 1913 the production of zinc was 22,757 t. and of lead 2700 t.

Cement.—In the first quarter of 1921 Little Poland manufactured 19,000 t. of cement and exported 5850 t., whilst Congress Poland exported 2100 t. out of a production of 13,500 t.

Alcohol.—Like Czechoslovakia, Poland is desirous of developing an export trade in alcohol, and negotiations are now proceeding with the Polish Ministry of Finance with that end in view.

Zinc Production in 1921.—During the twenty years before the war the demand for zinc rose steadily and the output amounted to a threefold increase. Production reached its peak in 1913, and during the war again in 1916, but was more affected than that of any other metal by the subsequent world crisis, falling from 1 million metric tons in 1913 to 648,000 t. in 1919. In 1920 production rose again to 715,000 t. and in 1921 to approximately 800,000 t. Within the last ten years Europe and the United States have practically changed places in the production of zinc; whereas European production has declined from 69 per cent. to 33 per cent. of the world's output, that of the United States has increased from 31 to 62 per cent. In the same period (10 years) the world demand has dropped from 1 million t. to 667,000 t.; the consumption in Europe is now 350,000 t., compared with 700,000 t.; in Germany the demand has fallen by one-third. During 1921 prices in New York varied between \$92 and \$120 per ton; in Germany they have recently tended to rise as the industry has attempted to protect itself more strongly against internal inflated values.

Hull Chemical and Engineering Society.—At the closing meeting of the session held last month, the retiring president, Mr. A. R. Tankard, delivered an address on "The Influence of Science on Human Life," in which he submitted that it was Science, rather than the Arts, that has had the greatest influence on man in modern times. Science deals with Nature against whom man is continually warring, and knowledge of Nature is alone of use in this contest. Those who decry the great discoveries of science are ignorant of its fundamental inductive method and of the creative use of the scientific imagination. Modern research has thrown light upon a number of problems almost as old as man himself, *e.g.*, that of the constitution and evolution of matter. The idea of evolution has probably had more influence on human life than any other scientific concept. Inventions based upon discoveries in pure science have built up our present-day civilisation, cured our bodily ills and added to the amenities of life. Distance has been annihilated and the path has been opened up for a better understanding among the peoples.

PERSONALIA

Dr. E. S. Simpson, Mineralogist to the Government of West Australia, has received the additional appointment of Government Chemist and Analyst.

The vacant headship of the Rowett Institute, Aberdeen, has been filled by the appointment of Mr. W. Godden, lecturer in agricultural chemistry in the University of Leeds.

The American Electrochemical Society has conferred an honorary membership upon Dr. C. Hering, one of the founders of the Society and well known for his work on electric furnaces.

Sir Thomas H. Holland has been appointed Rector of the Imperial College of Science and Technology, as from September 1, 1922, in succession to Sir Alfred Keogh, who will then retire under the age limit.

Prof. H. Sjögren, director of the mineralogical department of the State Museum in Stockholm, and formerly professor of mineralogy and geology in the University of Upsala, died on March 24, aged 66 years.

Dr. Arthur Traube, who originated the "Uvachrome" process of colour photography, has been awarded the gold medal of the Photographic Society of Vienna in recognition of his work in the field of colour photography.

Prof. H. R. Moody, professor of industrial chemistry and chemical engineering in the College of the City of New York, has been appointed to succeed the late Prof. C. Baskerville as director of the department of chemistry in the College.

Prof. C. L. Fortescue, of the Royal Naval College, Greenwich, has been appointed to succeed Prof. T. Mather in the chair of electrical engineering in the City and Guilds (Engineering) College of the Imperial College of Science and Technology.

Prof. Robert Robinson, who was appointed last year to the chair of organic chemistry in the University of St. Andrews, has now been appointed to a similar chair in the University of Manchester. It is probable that Prof. Robinson will enter upon his new duties at the end of the Lent term, 1923.

Dr. Herbert Levinstein, states *The Times*, has resigned his position on the Board of the British Dyestuffs Corporation because he feels that the technical direction of the company is not strong enough to enable it to compete successfully with the Germans and the Swiss, and to carry out successfully the objects for which the Corporation was created.

Dr. F. Quinke has succeeded Prof. H. Ost as professor of technical chemistry in the Technical "Hochschule" in Hannover. Dr. H. Fleissner has been appointed professor of general and analytical chemistry in the German Technical "Hochschule" in Prague, and Prof. K. Freudenberg, of Freiburg University, has been offered the chair of chemistry in the Karlsruhe Technical "Hochschule" recently vacated by Prof. P. Pfeiffer.

We note with regret the death, at the age of 74 years, of Prof. Henry Marion Howe, professor emeritus of Columbia College, New York, who, as author, teacher and investigator, did much to develop the science and practice of metallurgy, with particular reference to iron and steel. He played an important part in introducing manganese steel into the United States, and among the many honours he received was that of Bessemer Gold Medallist of the Iron and Steel Institute in 1895.

REPORTS.

REPORT ON THE INDUSTRIAL AND ECONOMIC CONDITIONS IN NORWAY, DATED DECEMBER, 1921. By C. L. PAUS, H.M. Commercial Secretary, Christiania. Department of Overseas Trade. Pp. 81. London: H.M. Stationery Office. 1922. Price 2s. 3d.

Industry in Norway was severely depressed throughout 1921, and at the end of the year there were no signs of improvement. The lumber industry was very active in the winter of 1920-21, but although large orders had been placed by the cellulose and pulp mills, prices declined and much timber remained unsold. Production of lumber during the winter of 1921-22 was probably small, as the cellulose mills held stocks sufficient for two years. There was acute distress in the fishing industry, the demand for herring oil was poor, and the fall in the price of whale oil from £90 to £31 5s. per ton caused heavy losses. The production of whale oil was 273,090 barrels, compared with 210,673 barrels in 1920 and 581,292 barrels in 1913.

Manufacturing industries suffered from foreign competition, the depreciated currency, and high cost of living and high wages. The demand for wood-pulp and paper was limited, prices did not cover cost of production and stocks accumulated; the estimated production of cellulose in 1921 was about 150,000 tons, as against 224,000 t. in 1920. Prospects were better at the end of 1921; demand improved, the German mills were not free to take fresh orders and foreign stocks were decreasing.

The mining industry also suffered from poor demand and high costs of production. The output of iron ore was reduced to a minimum, that of pyrites did not exceed 20 to 30 per cent. of the normal, and the copper-smelting works, nickel-ore mines and refineries, chrome-ore and molybdenite mines were closed throughout the year. There are large stocks of pyrites, exports of non-cupreous and cupreous pyrites probably did not exceed 70,000 t. and 80,000 t., respectively, and the home demand was limited by competition from American sulphur and by depression in the cellulose industry. The depression in the mining industry greatly reduced the consumption of explosives, but the explosives factories benefited from a larger demand from agriculture and forestry. The match factories held large stocks and reduced their output.

The manufacture of calcium carbide practically ceased, but most of the large stocks held at the beginning of the year are said to have been sold at a loss. Ferrosilicon was in small demand in the United Kingdom, the chief market, and prospects for carbide, ferrosilicon and ferrochrome were uncertain, although the export trade in carbide was expected to improve as a result of the explosion at Oppau. Production of cyanamide in Norway has ceased, it is believed permanently. The nitrate factories of the Norsk Hydro-Elektrisk Kvalstof A./S. maintained a fair output, the factories at Rjukan were working at full capacity, but those at Notodden have been short of water. Production of aluminium was small, but the A./S. Høyangfaldene is said to be producing it from German alumina at the rate of 5000 t. per annum; the output of this company was expected to increase to about 7000 t. in 1922. The zinc smelters have found difficulty in procuring zinc concentrates owing to the small output of the mines; one factory has begun to make zinc plates, two others have been mainly occupied in redistilling brass waste, and a fourth, under Swedish control, is in financial difficulties. The oil-hardening, margarine, soap, milk-preserving, cement and tanning factories had a bad year, but the linseed- and coconut-oil mills did well. Although

various hydro-electric schemes have been put forward since the war and some little progress has been made, it is thought that unless the electrochemical and electrometallurgical industries receive some new impetus, the water-power already harnessed will meet the demand for some years.

The demand for all classes of goods was small throughout the year, and although a good deal of business went to Germany on account of the depreciated mark, purchases were limited to necessities. Germany displaced the United Kingdom as a source of galvanised sheets and lead, but British exporters secured most of the trade in copper, tin and antimony. Tinplate was in small demand, and the Norwegian product is now competing in price with that from England. Owing to the depression in the pulp and paper industry, the consumption of heavy chemicals was restricted, and the small amounts required were imported from Germany. Fertilisers and feeding stuffs were in good demand, and increased sales were anticipated.

REPORT ON THE COMMERCIAL, INDUSTRIAL AND ECONOMIC SITUATION IN ITALY, DATED DECEMBER, 1921. By J. H. HENDERSON, *H.M. Commercial Secretary, Rome. Department of Overseas Trade.* Pp. 70. London: *H.M. Stationery Office.* 1922. Price 1s. 9d.

Excess of national expenditure over national income, excess of imports over exports, and internal unrest are the outstanding difficulties with which Italy has to contend, and the means of solution advocated are intensified agricultural production and improved transport facilities. The crop yields generally improved in 1921, although the production of wine and olive oil declined. A State Department has been organised to control the lignite, peat and shale undertakings established during the war and the mining industry is now being decontrolled. The State, however, will continue to direct exploration for minerals and petroleum and will grant subsidies when the cost is too great for private enterprise. It is expected that legislation to socialise mineral resources will be introduced shortly. Good progress has been made in water-power development; the total power harnessed rose from 935,000 h.-p. in 1915 to 1,452,120 h.-p. in 1920, and schemes are in hand for developing a further 700,000 h.-p.

Industry generally was very depressed throughout 1921, although at the end of the year there was some improvement in textiles and in certain of the metal industries. The chief problem of the metal industries lies in the necessity for importing costly raw materials, especially coal, and this has forced the steel manufacturers to pay most attention to the rolling mills and forges as these utilise electric power. If all the Italian steel works were to produce at full capacity, the normal home requirements could be more than satisfied. The tinplate and certain other branches of the industry have been busy; and some relief will follow the liquidation of the Ilva and Ansaldo companies, which, it is said, have devoted to finance and politics the resources which should have been reserved for the metallurgical industry. The works that make sulphuric-acid by-products have taken advantage of the fall in demand since the armistice to renovate their plant, and are now working on a normal basis. German competition is affecting the dyestuffs industry, which is urgently demanding fiscal protection. Progress has been made by the fertiliser industry, which can now supply home requirements in superphosphates; nitrogenous fertilisers are still imported, but much is hoped from the factory recently established to manufacture ammonia by the Casale process (*cf. J., 1921, 312 n*). The ceramic industry is suffering from German and Austrian

competition and from the need of importing the raw materials required for making the finer qualities of glass and pottery. The paper industry is also menaced by foreign competition and large stocks have accumulated. Exports of citric acid and tartar products, however, are growing in importance (*cf. J., 1922, 159 n*). The average wages in lire (lira=9½d. at par, now 28d.) per 8-hr. day in various industries were as follows:—Engineering 25, aluminium ware 28, glass 55, pottery 20, chemicals 20, paper 12·50, and gas-mantles 15. It is expected that the new customs tariff, which provides protective rates for chemicals, dyes, paint, glass, metals, etc., will bring about improved conditions.

In the first half of 1921 imports decreased by 511 million lire to 13,455 mill. lire, and exports by 703 mill. lire to 5282 mill. lire, the adverse trade balance rising by 162 mill. to 8173 mill. lire; calculated on another basis, however, the adverse trade balance fell by 3638 to 4373 mill. lire. England's principal competitors in the Italian market are Germany and the United States, and of these the former is by far the more formidable on account of the depreciated value of the mark. Germany's principal imports from Italy are hemp, silk, and citrus fruits, and the principal exports, machinery, iron and steel, dyes and chemicals, tanned hides, and small hardware. During the first half of 1921, the volume of trade between Italy and Germany was practically the same as between Italy and France. These countries took the third place in Italian foreign trade, the United States being first and Great Britain second.

With some exceptions, *e.g.*, coal, textiles and machinery, there is practically no demand for British products in Italy, owing to high prices, the existence of large stocks, increased local production, and the failure of British exporters to study the market. Rapid and direct communication by rail between England and Italy would greatly assist trade between the two countries.

To the report on Italy is annexed a short report on the trade and industry of Benghazi, Cirenaica, N. Africa.

INTERIM REPORT OF THE ENGINEERING COMMITTEE OF THE EMPIRE MOTOR FUELS COMMITTEE.

This report, signed by Dr. W. R. Ormandy, relates to tests made on alcohol by Mr. Ricardo with the variable-compression engine which he designed and built for the Anglo-Asiatic Petroleum Company. By special permission of the Government undenatured alcohol was allowed to be used for these tests.

Tests for power, consumption and efficiency were made over a very wide range of conditions, including varying compression, load, mixture strength, piston speed, etc. The results show very clearly that in many directions alcohol offers certain advantages over petrol or benzol. At both high and low compressions the thermal efficiency of alcohol is higher than with hydrocarbons, and, further, the efficiency is almost independent of the speed.

Tendency to pre-ignition began to be evident at 7:1 compression, and in practice 6·5:1 is probably the maximum ratio which should be given to engines specially designed for this fuel. In all cases the running is much smoother than with hydrocarbon fuels. The report shows in general that alcohol can be employed in all existing types of volatile-fuel engines from the paraffin engine upwards, and in specially designed engines of high compression, and that in every case the thermal efficiency is greater than with hydrocarbon fuels. In low-compression engines the consumption of fuel is, of course, greater with alcohol, owing to its lower heat of combustion, but the consumption can

be reduced very greatly by increasing the compression.

The cylinder is more easily kept cool when using alcohol than when using hydrocarbons, and this condition favours power-output and efficiency. The presence of water in alcohol is also an advantage in this direction, and it is shown there is no evidence that, up to a piston-speed of 2000 per min., the combustion is too slow to produce maximum effect. Tests were made in which heat was supplied at the rate of 3 h.p. to the carburettor and it was found that the power-output was somewhat reduced but the thermal efficiency slightly increased. No corrosive action was observed on any part of the engine as a result of using alcohol under any conditions.

The carrying out of the tests has entailed many hundreds of readings, but the work, taken in conjunction with the research already organised and carried through by the Committee, should be of very great value in that, in place of wild guesses as to the behaviour of fuel in engines, definite information is now available.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Dyes (France and Germany).

In reply to Major Barnes, Mr. Baldwin said that he had no reason to suppose that the British Dye-stuffs Corporation was contemplating an arrangement with the Interessengemeinschaft similar to that reported to have been made by the latter and a French company (*cf. J., 1922, 201 n.*).—(May 4.)

Dyestuffs (Import Regulation) Act.

Replying to Sir W. Barton, Mr. Baldwin said that the application for a licence to import a small quantity of Algele 5 G powder was refused because the British product was of satisfactory quality. If the consumers would furnish information to show that, on a basis of price per lb. and tinctorial value, the British dye cost over three times more than the German one, the question would be considered further. He thanked Sir W. Barton for the information that the Licensing Committee now required the dye-users to prove that the greater price of the British dye injuriously affected the competitive position of the finished product, and that the ordinary dyer usually did not know this, as his work was confined to the dyeing.—(May 4.)

In moving a reduction of the vote for the Board of Trade, Capt. W. Benn attacked the trade policy of the Government. Sir W. Pearce, who replied, observed that but for the Dyestuffs Act and the Safeguarding of Industries Act the organic chemical industry of the country would have disappeared. Mr. Fildes claimed that the Dyestuffs Act had no redeeming feature, and quoted figures to show that prices of dyes were so high as to threaten the existence of the textile industry. Sir W. Barton criticised the methods of granting import licences, but said that the dyer could not show that the high cost of the dyes affected the competing power of the dyed goods. Mr. W. J. U. Woolcock described the work of the licensing committee and observed that the onus of proof of excessive cost had been accepted by the colour user. In reply, Mr. Baldwin said that it would soon be time to review the effects of the two Acts, and if he could make any improvements that would mean less trouble or greater efficiency he would. The motion to reduce the vote was defeated by 177 votes to 67.—(May 4, 11.)

Imports of Glass Bottles.

Answering Mr. Hogge, Mr. Baldwin gave the following figures of the imports into the United Kingdom of glass bottles from Germany and Holland in 1913 and 1921:—

		Quantity. Gross.	Declared value. £
From Germany:—			
1913	936,917	422,367	
1921	830,848	389,116	
From Holland:—			
1913	125,086	64,713	
1921	280,898	439,126	

—(May 8.)

Australian Zinc Concentrates and Spelter.

In a written answer, Sir W. Mitchell-Thomson informed Capt. W. Benn that the Government had received to date 836,000 tons of concentrates and 5000 t. of spelter, and that 139,000 t. of the former and 3000 t. of the latter had been sold for £443,500. The trading accounts to March 31, 1922, which were not yet ready, would probably show a considerable loss on the transactions.—(May 9.)

Prices of Coal.

Replying to Sir R. Clough, Mr. Bridgeman said that the average declared f.o.b. value of coal exported in March was 22s. 3d. per ton, which was estimated to be equivalent to an average price of 17s. 6d. to 18s. 6d. at the pit. Pithead prices for home industrial coal ranged from a few shillings per ton for inferior slack to about 27s. per ton for large steam coal, but there was no reason to suppose that there was an appreciable difference between the export and home prices for the same quality.—(May 9.)

School of Hygiene (Rockefeller Gift).

Sir A. Mond, replying to Messrs. Myers and Naylor, stated that the sum of \$2,000,000 given by the Rockefeller Foundation would be used for providing and equipping a school of hygiene, which would be staffed and maintained by a Government grant. A site in Bloomsbury had already been acquired by the Foundation. The object of the scheme was to promote public hygiene and health by providing facilities for educating medical men and for research in preventive medicine. The work of the school would be organised so as to fit in with similar work done in existing institutions.—(May 10.)

Spirits Duty (Perfumery).

Answering Mr. Lyle, Sir R. Horne said he was aware of representations that the duty of 74s. per proof gallon on perfumery was crippling the industry, but he was unable to adopt the suggestion that either the perfumery industry should pay a smaller duty, or manufacturers should be allowed to mature spirit and manufacture perfumery in bond.—(May 11.)

Safety Lamps for Coal Mines.

In reply to Major Barnes, Sir R. Horne said that the manufacturers of safety lamps had received no financial assistance from the State and any remission of excess profits duty that they had been allowed was authorised by law for trades in general.—(May 11.)

Geological Survey.

Answering Mr. E. Harmsworth, Mr. Fisher stated that the number of the staff and expenditure of the Geological Survey for the current year were 81 and £41,560, respectively, compared with 51 and £16,828 in 1914. The increase was necessary for obtaining information required in developing the country's mineral resources.—(May 15.)

Exports of Coal.

Mr. Bridgeman, responding to Mr. G. Baker, said the exports of coal in the first four months of 1922 were 17,333,082 tons, of an average f.o.b. value per ton of 22s. 8d., as compared with 22,641,387 t. and 13s. 9d. during the same period of 1914.—(May 15.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Aluminium Hollow-ware.—Imports of German hollow-ware into the United Kingdom during 1921 amounted to 659 tons, valued at £130,828, and to 172 t. during March, 1922. According to German official trade returns, which do not show hollow-ware separately, 229 tons of "unspecified manufactures of aluminium, including aluminium foil" was imported into this country during 1913.—(May 4, 8.)

Scientific Instruments and Appliances.—The imports of scientific instruments and appliances from Germany during the 6 months ended March 31, 1922, included:—Sensitised photographic paper £7081; photographic plates and films £14,740; lenses, prisms, etc. (1,035,208 pieces) £29,706; precision balances £2987; mathematical instruments £24,063; X-ray and vacuum tubes, wireless valves, etc. £815. The amount of duty collected during the period was £175,293. Sensitised photographic paper, plates and films are not dutiable.—(May 8, 16.)

Santonin.—The total cost of the Santonin case, including charges for shorthand notes, will be approximately £135.—(May 9.)

Sodium Pyrophosphate.—The lists of dutiable articles have been amended in the light of the Referee's decisions, but sodium pyrophosphate (cream of tartar substitute) is retained in the lists as no complaint concerning it has been received.—(May 15.)

Radium Bromide is dutiable under the Act and the Board of Trade has no power to remit the duty on radium imported for therapeutic use.—(May 15.)

Revenue.—The duty collected on articles held by the Referee to have been improperly included in the lists issued under Part I of the Act amounts to £10,249.—(May 15.)

HOUSE OF LORDS.

Merchandise Marks Bill.

This Bill, which has now passed the Report stage, empowers the Board of Trade, after inquiry, to order an indication of origin to be given for goods whose form, style, or finish gives a false impression of their origin; goods intended for re-export and certain other goods are exempted. If a body representing a substantial portion of any trade applies for an order, the Board will then make the necessary inquiries. Under Section 2 the application to goods of national or public devices can be prohibited if such use appears likely to give the false impression that the goods are made or produced in the United Kingdom or some other part of the Empire. Section 3 regulates legal proceedings, which are not to be taken except with the consent of the Board of Trade or the Minister of Agriculture, and Section 4 prohibits the importation into the United Kingdom of goods bearing a forged trade mark or false trade description. Section 5 provides that the indication of origin may not be removed from goods exempted from prohibition because they bear such indication. Parts II., III., and IV. of the Bill regulate the use of Government marks, Royal arms and devices, and define the powers of the Board of Trade under the Bill.

TRADE NOTES.

BRITISH.

Trade of the United Kingdom, Jan.-Mar., 1922.—The following details of exports of chemicals and allied products from the United Kingdom in the first quarters of 1913, 1920, 1921, 1922 are abstracted from returns published in the *Board of Trade Journal* for April 20:—

		January—March			
		1913	1920	1921	1922
China-ware, etc.	1,000 tons	48.7	36.0	42.5	38.2
Glass bottles	1,000 gross	228	115	106	80
Glassware, other	1,000 tons	11.7	5.3	5.0	5.4
Cement	"	10.8	6.5	4.6	4.1
Copper manufactures	"	9.9	11.0	8.3	9.7
Lead manufactures	"	11.2	9.3	4.2	7.5
Tin manufactures	"	3.0	4.0	2.7	3.3
Ammonium sulphate	"	83	26	52	41
Sodium compounds	"	80.0	105.8	63.7	108.3
Painters' colours	"	28.1	10.1	12	13.9
Soap	"	21.7	29.8	7.3	14.0
Paper and cardboard	"	44.7	21.8	23.1	20.2
Vegetable oils, edible	"	10.5	6.2	8.6	5.7
Vegetable oils, crude	"	13.6	26.6	14.7	24.2

Compared with the returns for the last quarter of 1921, the trade in most products in the first quarter of 1922 shows a slight improvement.

FOREIGN.

New Increases in the Prices of Nitrogenous Fertilisers in Germany.—On April 26 the prices of the following fertilisers were raised from 4200 to 5350 pfennigs per kg. per cent. of nitrogen:—Ammonium sulphate, ammonium chloride, sodium-ammonium sulphate, sodium-ammonium nitrate (with 40—45 per cent. rock salt), potassium-ammonium nitrate, ammonium nitrate with a minimum of 3 per cent. of bone meal, ammonium nitrate with 40 per cent. gypsum, and ammonium sulpho-nitrate. Other increases are as follows:—Dried ground ammonium sulphate, from 4300 to 5480 pfg.; sodium nitrate, from 5070 to 6160 pfg.; and calcium cyanamide, from 3740 to 4760 pfg. The prices of blood meal and horn meal remain at 3000 and 2600 pfg., respectively.

Potash Prices in Germany.—The Potash Syndicate has increased the prices of potash by 34 per cent. above those current on April 1. Previous increases in price have been as follows:—Sept. 1, 1921, 35%; Dec. 7, 1921, 70—80%; Feb. 20, 1922, 15%; March 22, 1922, 21%; April 1, 1922, 4.4%. The price of 1 per cent. of K₂O for crude potash salts (12—15 per cent. K₂O) in lots of one quintal has risen from 11.5 pfennigs in 1915 to 23 pfg. in 1918, 60 in 1919, 90 on April 21, 1921, 199 on December 7, 1921, 229 on February 20, 1922, 277 on March 22, 289 on April 1, 1922, and, with the latest increase, to 387 pfennigs. The fear that this last increase in price, together with the decision that export prices are not to be less than prices for the home consumer, will injure the export trade is not shared by the Syndicate, although a decline in trade with countries with very low exchange rates, such as Austria, is anticipated. The decision to increase the price of potash was taken by the German Government on April 29.

Trade of Czechoslovakia in 1921.—Imports into Czechoslovakia during 1921 amounted to 3,961,000 metric tons and included:—Coal, 1,133,000 t.; minerals, 605,000 t.; sugar, 447,000 t.; iron and manufactures of, 127,000 t.; and the exports, 9,645,000 t., comprised:—Coal, 7,632,000 t.; minerals, 820,000 t.; chemicals 158,000 t.; iron, 199,000 t.; glass, 132,000 t. For the first eleven months of 1921 the imports were valued at 23,384 million kronen and the exports at 27,569 mill. kr. (krone=10d. at par, now about 1.1 d.). It is stated that employment has increased, especially in the metal and building industries.—(*U.S. Com. Rep.*, Mar. 13, 1922.)

Spanish Trade in Pyrites.—During the first half of 1921 the sales of pyrites produced in the Spanish province of Huelva amounted to 671,645 metric tons, compared with 754,713 t. and 1,693,972 t. in the same period of 1920 and 1913 respectively; total sales fell from 3,937,945 t. in 1913 to 1,509,426 t. in 1920. This decline of roughly 60 per cent. in the exports is due to the economic situation in Europe and to the development of domestic resources of sulphur in the United States. Germany, although buying smaller quantities, is still the chief consumer. The distribution of the exports in 1913, 1920, and in the first half of 1921 was as follows:—

	1913	1920	1921
		Metric tons	Jan.-June
Germany and Holland	1,051,885	326,816	219,227
France	437,212	269,539	175,757
England	627,229	504,814	112,484
United States	783,504	229,850	83,751
Belgium	182,201	66,201	83,221
Denmark	12,083	20,465	11,854
Australia	10,158	—	1,332
Scandinavia	31,338	81,187	—
Other countries	138,964	7,329	—

The consumption in Spain represents only about 5 per cent. of the total sales, viz., 73,371 t. in 1913, 53,225 t. in 1920, and 33,509 t. in the first half of 1921. The proposal to apply an export duty to Spanish pyrites is viewed with apprehension, as not only is there already little margin between the sale price and cost of production, but the industry depends entirely on the export trade and the prospects of increased home consumption are small.

Trade of Soviet Russia in 1921.—From data prepared by the Commissariat of Foreign Trade, it appears that the imports into Russia during 1921 were valued at 133,593,486 gold roubles, compared with 1,389,800,000 roubles in 1913 (gold rouble = 2s. 1d. at par). These imports originated as follows (the figures for 1913 are given in parentheses):—Esthonia, 41%; England, 36% (12.6); Sweden, 10% (1.2); Germany, 6% (47.5). Statistics are given showing the origin of the commodities imported in the year ended October 31, 1921, but it is not clear whether the figures refer to actual deliveries or only to orders; it appears, however, that by values, chemicals, medicines, and paper represented the following percentages of the imports from each country:—Germany, 6.3%; Sweden, 10.7%; Lithuania, 1.0%; England, 0.5%; Esthonia, 17.2%; and Finland, 17.2%. Exports during the same period were valued at 16,734,650 roubles (1,520,131,721 roubles), and included minerals and metals 967,031 rbls., and drugs and chemicals 495,042 rbls.; 50.8 per cent. went to England, 19.7 to Germany, 14.0 to Latvia and 6.6 to Norway. It should be noted that the figures of the trade with the United Kingdom do not tally with those published by the Board of Trade and that a substantial portion of the trade has been credited to the transit countries of Latvia and Esthonia.—(*U.S. Com. Rep.*, Mar. 27, 1922.)

Nitrate Trade of Chile.—The Acting British Consul at Antofagasta reports that during the second half of 1921, 429,932 tons of nitrate was produced and 323,447 t. exported, and these figures represent decreases of about 65 per cent. and 74 per cent., respectively, on those for the corresponding period of 1920. Stocks held by the Nitrate Pool at the end of 1921 amounted to 731,500 t., excluding 90,000 t. afloat and 6000 t. ready to be embarked. Of these stocks 260,000 t. was in France, 210,000 t. in Belgium, 82,000 t. in the United Kingdom, 72,000 t. in Holland, and 61,000 t. in Germany and the Baltic States. The Pool states that 205,000 t. was sold for delivery between January 1 and April 30, 1922, but that there were no buyers for deliveries after April. It is believed that the stocks in hand will last until June 30.—(*Bd. of Trade J.*, Apr. 13, 1922.)

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for May 11 and 18.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number:—

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REFERENCE NUMBER.
Argentina	Iron and steel	5526/F.L./E.O.
Australia	Paint, varnish	651
"	Tinplate	780/53/F.G./E.C.G.
"	Drugs, pharmaceutical preparations	557
"	Drugs, chemicals	•
Belgium	Chemicals, drugs, rubber goods, paper	532
"	Starch	570
Brazil	Glass, pottery	225/75/F.G./M.C.
British India	Paint, reinforcing materials	523
"	Copper wire (tender for)	3739/3 T.G.
Canada	Glass bottles	†
Chile	Tinplate, galvanised sheets, iron and steel	553
China	Earthenware, galvanised and plain sheets, sheets of non-ferrous metals	549
Cuba	China, earthenware, stoneware	554
Danzig	Soda, technical oils and fats for soap making	571
Denmark	Tinplate	572
Egypt	Drugs (tender for)	7971/F.E./S.C.
"	Lead products	7624/F.E./E.C.
"	Paper, bristol and mill board (tender for)	8145/F.E.
Germany	Drugs	535
Hungary	Chemicals	541
Italy	Soap, perfumery, electric lamps, preparations for polishing metals	542
New Zealand	China, earthenware	8446/E.D./M.C.
"	Iron and steel	4182/E.D./E.C.
Palestine	Soap	529
South Africa	Galvanised sheets	530
Spain	Iron and metal sheets	546
"	Soap, perfumery, matches	547
Straits Settlements	Perfumery	769/55/F.G.
Switzerland	Copper plates	15372/F.W./E.C.
"	Leather	583
United States	Perfumes	15279/F.W./G.C.
"	Glass and glassware	225/4/F.G./M.C.A.

* 412/20/7/2083. Official Secretary, Commercial Bureau, Australia House, Strand, London, W.C.2.

† High Commissioner for Canada, 10, Victoria Street, London, S.W.1.

TARIFF. CUSTOMS. EXCISE.

British Honduras.—Revised schedules of import duties and free goods came into force on April 1. Copies of the revised tariff may be seen at the Department of Overseas Trade.

British India.—The export of coal, except by the Crown or when used for bunkering, is prohibited. Urea is now admitted duty-free. The tariff valuations for mineral oil have been amended.

Egypt.—The duty on denatured spirits has been reduced from 6 to 3 millimes per kg. The *ad valorem* duty on medicinal preparations containing

distilled alcohol and to be found in a recognised pharmacopœia has been replaced by the specific rate of duty on alcoholic liquids.

France.—Export prohibitions have been withdrawn from coal, coke, and certain prepared hides and skins.

Germany.—Imported foreign coal is exempted from the coal tax during the period May 1—August 31, but still requires an import licence. By an ordinance dated May 8, the customs duties have been increased (mostly doubled) on soaps, perfumery, certain pharmaceutical products, leather wares, paper, stoneware, earthenware, glass and glassware, wares of precious and of common metals.

Japan.—From March 30 the import duties on copper, brass and bronze have been increased.

Kenya.—The export duty on hides has been suspended until the end of the year.

Luxembourg.—By virtue of the economic union between Belgium and Luxembourg, which came into force on May 1, all the laws and regulations in force in the Duchy to control customs and excise have been replaced by the customs and excise regulations in force in Belgium.

Nigeria.—An import duty of 10 per cent. *ad valorem* has been applied to corrugated iron sheets; the *ad valorem* duty on glassware, manufactures of brass, copper and zinc, candles, perfumery (not perfumed spirits) has been fixed at 15 per cent.; and the existing *ad valorem* duties have been raised from 12.5 to 15 per cent.

Palestine.—A complete list of the customs duties is given in the issue for May 11. The general import duty is 11 per cent. *ad valorem*, but the rate on various metal products, glass, bricks, fire-bricks, etc. is 3 per cent. *ad valorem* and fertilisers are admitted duty free. Special licences are required for imports of blasting explosives, saltpetre, picrates, potassium and sodium chlorates, cocaine, sulphonal, and opium.

Peru.—Cottonseed may not be imported after March 31.

Russia.—The prohibition of the possession of gold, silver, platinum, and precious stones has been removed and dealings therein are now permitted.

St. Vincent.—The import duties specified in the Ordinance of 1920 have been increased by one-tenth. Regulations have been issued for assessing the value of goods dutiable on an *ad valorem* basis.

South Africa.—Regulations for the sale of pest remedies, other than registered stock dips, come into force on July 1.

Under the new Budget it is proposed to apply duties of 1d. per lb. on starch and of 3d. per gross on corks, and to increase the duties on goods "dumped" by countries with depreciated currencies.

Spain.—Further changes in the import tariff are given in the issue for May 18. They affect kaolin, calcium carbonate, gypsum, mineral oils, glass, iron and steel products, copper and copper ores, sulphur, certain salts of magnesium and mercury, hardened fats, various organic acids, and vulcanised rubber.

Sweden.—A duty of 2 kr. per kg. is payable on bleached artificial silk.

United States.—A partial reprint of the proposed new customs tariff is given as a supplement to the issue for May 11. The "free list" includes many raw materials, e.g., crude vegetable drugs, dyeing and tanning materials, gums, resin, rubber, oil-seeds, vegetable and mineral oils, crude minerals, various ores, fertilisers, in addition to chemicals such as hydrochloric, sulphuric, nitric and chromic acids, ammonium nitrate, borate materials, certain calcium salts, coal and various coal-tar products, copper and iron sulphates, tin, rare metals, iodine and sulphur. Special provisions are proposed to prevent "dumping" from countries with depreciated currencies.

GOVERNMENT ORDERS AND NOTICES.

SAFEGUARDING OF INDUSTRIES ACT. Part I.—On May 22 the Referee gave judgment on the complaints relating to the improper exclusion and inclusion, respectively, of incandescent gas-mantles and of camphor (synthetic) and pinene, as follows:—(1) That the lists be amended by including therein "mechanical aggregates of oxide of thorium and oxide of cerium and of nitrate of thorium and nitrate of cerium being ingredients of incandescent gas mantles." (2) "That pinene and synthetic camphor be removed from the list and that the words 'Komppa's synthetic camphor' be added." [Pinene was withdrawn from the lists on April 6.]

Part II.—The Board of Trade has given notice that optical elements, whether finished or not, manufactured in Germany, shall be included in the terms of reference of the Committee appointed to hear the complaint regarding optical and scientific instruments; also that a complaint from the Incandescent Mantle Manufacturers' Association in respect of gas mantles made in Germany has been referred to a Committee under Part II.

REVIEWS.

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTRY. By J. W. MELLOR. Vol. I. HYDROGEN AND OXYGEN. Pp. xv+1065. (London: Longmans, Green and Co. 1922). Price £3 3s. net.

To write an adequate review of a volume designed on a scale so monumental as this new treatise, is a difficult task to one who is not blessed with the reviewer's instinct or with the pen of a ready writer. A first volume of over 1000 pages with more than 750 words on a page, devoted to hydrogen and oxygen seems almost to imply a Teutonic inspiration and to demand the Teutonic epithet "Kolossal!" Indeed, the *Handbuch der anorganischen Chemie* of Gmelin, Dammer or Abegg is deliberately challenged by this work, which aims not only at indicating what knowledge has been gained on any particular subject, but also at quoting the authority (with references) for each statement. We shall all admit that Dr. Mellor's courage in initiating this work and his patience in accumulating and ordering such a mass of material are deserving of our warmest admiration.

The work begins with a chapter on the evolution and what Dr. Mellor calls the methodology of chemistry. It is a small treatise in itself; it passes through the three eras of the mythological, the obscure and the certain—or, as they may be more accurately defined, the superstitious, the philosophical and the scientific stage. From the primitive chemistry of China, India, Egypt, Chaldea we are taken fairly fully through the philosophies of Greece, the alchemy of the Arabians, and so to the truly scientific work of Boyle, Hooke and Mayow. But the theory of phlogiston carried chemists off their feet, and *terra firma* was only regained by the work of Lavoisier. Chapter II., on Combination by Weight, gives not only the history of the discovery of the laws of chemical combination, but disquisitions on what is meant by an element, on the nature of evidence, on the evolution of the atomic theory, and of the language of chemistry. It might be suggested that where such detail is given as to the derivation of words, the phrase "spagyrical art" (p. 91) should be corrected to "spagiric," and the

Greek accents amended. Robert Boyle always used the correct spelling, "spagirist," but possibly Dr. Mellor was quoting from Shaw's edition of Boerhaave's *Chemical Philosophy* (1727):—"It is called the *spagyric art*, some say, from *σπαιρ* and *αγειρειν*, to separate and unite." Evidently Dr. Shaw did not bother about accents or iotas; but Boerhaave almost maliciously adds: "But it will admit of some doubt whether the ancient *Adepti* were so well versed in the Greek language."

It is inevitable, from the mode of treatment adopted, that there should be some repetition in the book. The evolution of the atomic theory in Chapter II. must overlap the evolution of the "element" in Chapter I.; and one is left in some doubt where to look for the full account of an author's work. But the method has this advantage that the student, let us say interested in Dalton, can skip Chapter I. altogether and find a readable and detailed account of the history of the atom in Chapter II. One item of repetition most readers will find annoying. Dr. Mellor gives us the full names of the chemists he cites, but he adds their initials to their names every time they are mentioned. He defends this practice on the ground that there are several chemists of the same name, and therefore accuracy demands the initials. But surely when we are discussing phlogiston and combustion there is only one Cavendish, one Lavoisier, one Scheele; when we talk of the laws of chemical combination there is only one Dalton, one Berthollet, one Gay-Lussac. Should not initials be reserved—or, still better, pre-names—for the great families of chemists, e.g., the Thénards and the Meyers?

Chapter III. gives in a little more than 20 pages the history of hydrogen and of the composition of water. The controversial part is fairly treated, and the only criticism to be made is the apparent lack of appreciation of Cavendish's work. It is not explained why Cavendish thought the hydrogen came from the metals dissolved, and the statement that he found the specific gravity of the gas seven times lighter than air surely should be eleven times lighter.

The short chapter on the physical properties of gases is excellent, and one's only regret is that the title "Charles' Law" is adopted against the evidence adduced.

Under the long chapter on Combination by Volume are included Avogadro's hypothesis and its results, the theories of types and of valencies (omitting modern electrons) and atomic volumes. In the chapter on the Classification of the Elements the "incomplete concordance" between the Periodic Law and atomic weights is fully discussed on the old lines, but only the shortest reference is made to "atomic numbers" and isotopes. They are to come later. The special chapter on hydrogen is interesting mainly from the descriptions given of methods for preparing and purifying hydrogen on the large scale, e.g., by the action of soda on ferro-silicon, or by the explosion of acetylene under pressure.

In the special chapter on Oxygen, Dr. Mellor hardly does justice to Scheele's work on "Fire-air." He explains clearly enough how Scheele imagined the fire-air (that made up a quarter of ordinary air) united with the phlogiston of the burning body to form "caloric" which escaped through the glass: but Dr. Mellor fails to show how Scheele deliberately set himself to reverse the experiment and obtain fire-air by decomposing caloric, which he passed into vessels containing substances like nitre and nitric acid, pyrolusite and mercuric oxide—chosen because they were known to be greedy to absorb phlogiston. The important chapter on Water includes the Phase Rule and its applications, and the probability of allotropic forms of ice and

water is fully discussed. Water leads on to Solution, and Solution to Crystallisation.

Dr. Mellor is perhaps most successful in his chapters on Thermochemistry and on the Kinetic Theory; he writes clearly and convincingly, and the text is not overlaid with mathematical equations.

One chapter is devoted to ozone and hydrogen peroxide, and the last two to Electrolysis and Electrical Energy.

The effect of so monumental a task as the author has imposed on himself is bound to reveal itself in some errors of commission or omission. The doctrine *Humanum est errare* is always present to Dr. Mellor's mind, and one is glad to notice that he remains human in spite of the magnitude of the work—and he does not degenerate into a machine. The mistakes, which the reviewer has observed, seem to him to be almost peculiar to the author. They are not ordinary slips or printers' errors but curious inversions of things the author is so familiar with that he must have transposed them unconsciously—by a sort of scientific "Spoonersism."

To take a few such inversions at random. Dr. Mellor has steeped himself in "Burnett" and other commentators on Greek philosophy, he knows the disputes which have been waged on the meanings of *ἀήρ* and *ἀέθρη* (air and aether), and that *ἀέθρη* has been claimed as "fire" and as the "quintessence" or the "moving cause"; he also knows that Aristotle taught that all things are made up of "indeterminate matter" *ἄν* on which properties, such as hot-ness and wet-ness, are impressed. And yet he states (p. 33) that Aristotle assumed the *quintessence* of matter to be the carrier of the four primitive qualities.

In describing the use of hydrogen for filling balloons, Dr. Mellor gives a formula for determining the lifting power of a gas with any molecular weight, and adds the astonishing statement that "a gas with a vanishingly small atomic weight would have a lifting power $7\frac{1}{2}$ times that of hydrogen"! It was puzzling to see by what inversion he had arrived at this "seven and a-half times," but on making the calculation the mystery was revealed when it appeared that the lifting power of a "vacuum" would be $7\frac{1}{2}$ per cent. greater than that of hydrogen.

Few chemists can be more familiar than Dr. Mellor with work done on the influence of moisture on chemical reactions. He rightly quotes Mrs. Fulham (1794) as a pioneer experimenter on this subject, and refers to her speculations on the burning of carbon, sulphur and phosphorus by abstracting oxygen from water. But when he puts into her mouth the statement (p. 377):—"In the first place carbon monoxide decomposed the water forming carbon dioxide and liberating hydrogen; . . . finally the nascent hydrogen united directly with the free oxygen, re-forming water," is he not unconsciously quoting from later work, forgetting at the moment that the nature of carbon monoxide was unknown in 1794, and that it was not recognised as a "gaseous oxide of carbone" until the experiments of Cruikshank in 1801?

Such an inversion as "one joule is equivalent to 4.106 calories" (p. 1033) can hardly be counted as a "Mellorism," anyone might have made it; but the constitutional formula suggested for crystalline copper sulphate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (p. 501)—which has nine hydrogen atoms and four oxygen atoms added to the anhydrous sulphate—should perhaps be added to the list.

In reality the book is singularly free from printers' errors, and the author and publishers are to be congratulated on producing a volume which must long be a standard book of reference. It is a compendium of information of which English chemists may be proud.

H. B. DIXON.

CHEMICAL WARFARE. By AMOS A. FRIES and CLARENCE J. WEST. Pp. xi+445. (New York and London: McGraw Hill Book Co., Inc. 1921.) Price 21s. net.

There is probably no aspect of the late war about which there is so much ignorance and misconception as the employment of gas. During the war it was obviously necessary to preserve the utmost secrecy both with regard to our own preparations and to the effects produced by the enemy's gas, but even since the armistice little has been published in English except Auld's "Gas and Flame" and Lefebure's "Riddle of the Rhine," dealing respectively with the military and technical aspects of the problem. The United States has attached considerable importance to publicity on this subject even at the risk of some loss of secrecy, and the present volume is a general account of gas warfare viewed from the American side, written with great frankness by the Chief of the American Chemical Warfare Service and one of his technical officers. No one is better qualified for this task than General Fries, who was Chief of the Gas Services of the A.E.F. in France and is now Chief of the peace establishment of the Chemical Warfare Service, so that he can speak with authority from the purely military side and also from an intimate knowledge of the research, supply and training organisation. He is an enthusiastic believer in the potency of gas as a weapon and in the enormous possibilities of gas warfare in the future, which make it one of the most vital problems of Imperial defence.

When the Americans joined the Allies in the spring of 1917 gas had already been in use in the field for two years. Profiting by our experience the Americans soon realised the importance of the new weapon, and after some initial difficulties and delays they organised a special service to deal with it, on a scale which was tantalising to the Allies whose resources in man-power and material were already strained to the utmost. General Fries, in describing the organisations in France and the United States, makes a generous acknowledgment of their indebtedness to the British Gas Services, and probably in no other branch was the co-operation of the Allies more intimate. The cordial relations that existed both between the research laboratories and in the field are remembered with pleasure by many British chemists.

Gas warfare developed rapidly and by 1917 it had assumed considerable tactical importance; special weapons, such as the Livens projector, had been devised, and the problem of providing an efficient respirator was becoming daily more complex. The authors deal in considerable detail with the successive types of gases which were used in the field, their properties, manufacture and tactical employment. The evolution of the respirator is also described at length, and the main chemical, physical and physiological researches involved. These chapters contain a great deal of material of general interest to chemists, such as the production of highly activated charcoal for use in respirators, a field in which American investigators led the way, and which is of special importance on account of the value of such charcoal for other purposes.

The concluding chapters deal with chemical warfare in relation to strategy and tactics, and with the offensive and defensive problems it presents for the future. A very strong case is made out by the authors for placing no special restriction on the use of gas in future wars as compared with other weapons. They prove by casualty statistics and other evidence that during the war gas caused less suffering than other weapons in proportion to the results obtained by it, and they point out that the illogical exclusion of so effective a weapon simply gives an advantage to an unscrupulous enemy. But in spite of such powerful arguments, it was on the

motion of the United States representatives at the Washington Conference that the use of gas has been prohibited in future wars. The decision was due mainly to public opinion actuated by sentiment and ignorance, and by the exaggerated statements in such books as Will Irwin's "The Next War" about the power of gas to blot out life over wide areas. Earl Balfour made it clear that Great Britain will continue research in gas warfare in order to provide against its illicit employment in the future, but there is a great danger, unless public opinion is properly informed, that insufficient effort may be devoted to this subject, especially when the lessons of the war become more remote. The American Chemical Warfare Service owes much to the support it has received from the American Chemical Society, and it is the duty of British chemists to make themselves acquainted with the facts as set out by General Fries. They cannot escape the responsibility for seeing that the safety of their country is not imperilled by neglect of the new weapon, the future possibilities of which they can best foresee.

ZIRCONIUM AND ITS COMPOUNDS. By FRANCIS P. VENABLE. *American Chemical Society, Monograph Series.* Pp. 173. (New York: The Chemical Catalog Company, Inc. 1922.) Price \$2.50 net.

This book is one of a series of monographs, the production of which was undertaken by the American Chemical Society by arrangement with the Inter-allied Conference of Pure and Applied Chemistry in 1919. The general introduction gives the reader to understand that the books to be published under this scheme fall into two series, (a) Scientific and (b) Technologic. To which series this book belongs is nowhere explicitly stated, but internal evidence places it in the former category, although the outstanding interest attaching to zirconium since the discovery of the remarkable Brazilian deposits of native zirconia has undoubtedly been of a technical nature. The sudden appearance of an abundant supply, albeit in a somewhat inaccessible quarter, of an earth having such valuable properties as a refractory, a substance hitherto obtained only with difficulty from the comparatively sparsely distributed zircon, was bound to awaken interest among those engaged in the commercial production or use of refractory materials. Important attempts have been, and are being, made to exploit this material and to overcome the peculiar technical difficulties which stand in the way of its full utilisation. It is disappointing, therefore, to find that in this book, out of 132 pages of text, only six pages are devoted to the technical applications of zirconium and its compounds, and only a few lines to the use of zirconia as a refractory. Mention is made of the production of zirconia crucibles and other chemical ware by the Royal Berlin Porcelain Factory. Little has been seen in this country of these products. They should have notable advantages over silica-ware for certain purposes, particularly for work at very high temperatures, if it has been found possible to avoid the use of such binding materials as lower the fusion temperature of the zirconia so much as to impair seriously its refractory properties. The fusion point of pure zirconia is, of course, so high that it cannot be possible to apply the technique of silica-ware manufacture to zirconia. No mention is made of the achievements of the Foote Mineral Company of Philadelphia, which placed on the market several years ago a zirkite fire-brick. At first clay was used as a binder but was soon found to be detrimental and was substituted by "zirkite cement," a finely-ground native zirconia.

The major portion of the book summarises the scientific literature of zirconium and its compounds, generally in a non-critical and non-committal spirit. Where so much is vague and indefinite the author is no doubt wise to postpone any attempt at separating the wheat from the tares. Zirconium salts are predominantly basic in character and in solution have a constant tendency to undergo further hydrolysis and to pass into a colloidal or semi-colloidal state. The chemical and physical properties of a solution of any zirconium salt are in almost every case a function of the previous history of the solution and of the solute. To non-recognition of this factor must be attributed many apparently conflicting observations by different workers. There is here, no doubt, a rich field of exploration for the student of the transition stage between the crystalloid and the colloid forms of matter. The chapter on analytical methods is chiefly valuable for a number of suggestions evidently garnered from the author's own experience. No pretence is made of giving full details of methods of separation and analysis, but full references to the literature are given in the bibliography. The extensive bibliography contains over 800 references to the scientific, technical and patent literature of zirconium, and appears to be reasonably complete. A separate list of patents is also given, with a brief indication of the claims covered by each.

The book is well printed and contains few typographical errors. There is some tendency to unnecessary repetition, as when we are told twice on one page that the zircons of Ceylon occur mainly in alluvial sands. There is a tendency also to allow questionable statements from the literature to pass into the book unchallenged, but as the book is intended as a guide to the literature for the benefit of the research worker, not as a critical treatise, the author may be pardoned on this account. The book must undoubtedly, if only on account of its bibliography, take its place as the standard work of reference for anyone seeking information or engaged in research on zirconium or its compounds.

E. H. RODD.

OBITUARY.

PROF. C. BASKERVILLE.

Dr. Charles Baskerville, who died on January 22 last at the early age of 51 years, was born at Deer Park, Mississippi, on June 18, 1870, and received his college education at the Universities of Mississippi, Virginia, Vanderbilt, North Carolina, and Berlin, graduating at the two last-named in 1894 and 1893, respectively. His career as a teacher began in 1891 when he was appointed instructor in the University of North Carolina; in 1894 he became assistant professor, and in 1900 professor. During this period he published many papers, mostly on the rare earths and rare metals, such as zirconium, titanium, vanadium, chromium, and thorium.

From 1904 until his death he was director of the chemical laboratories and professor of chemistry in the College of the City of New York, where he introduced many improvements in the chemical department. An active research worker, his investigations covered a wide field, including the manufacture and use of anaesthetics, methods of reducing losses in refining edible vegetable oils, the development of the oil-shale industry, and problems of the paper and pulp industry. An interesting result of his early investigations was the use of a mixture of oil and anaesthetic for colonic anaesthesia, a method now in daily use throughout the world.

As chairman of the American Chemical Society's Committee on Occupational Diseases in Chemical Trades, and as author of a Government report on the manufacture, uses and dangers of wood alcohol, Prof. Baskerville did exceedingly useful work; and recently he wrote several reports on methods of utilising surplus war materials. A total of about 190 papers, 16 patents, most of which were the result of his own work, and 8 books remain as a testimony to his untiring energy in the field of chemistry and its applications in the service of man.

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ERNEST SOLVAY.

Ernest Solvay was born at Rebecq, in the Province of Brabant, on April 16, 1838, as the son of Alexandre Solvay, quarry proprietor and Vice-President of the Chamber of Commerce of Nivelles; he died at Brussels on May 26, 1922. Although he had no opportunities for obtaining a university education, he became in 1859 assistant manager of the Gas Company of Saint Josse ten Noord, Brussels, under his uncle; whilst acting in this capacity he became interested in the manufacture of soda, probably because his father carried on the refinement of common salt on a small industrial scale. Previous to this time sodium carbonate had been manufactured exclusively by the process advocated by Leblanc in 1790, in which sodium carbonate was produced from common salt by aid of the following reactions:—

1. $2\text{NaCl} + \text{H}_2\text{SO}_4 = \text{Na}_2\text{SO}_4 + 2\text{HCl}$.
2. $\text{Na}_2\text{SO}_4 + \text{CaCO}_3 + 2\text{C} = \text{Na}_2\text{CO}_3 + \text{CaS} + 2\text{CO}_2$.

The Leblanc process derived its importance from the French revolutionary wars, which impeded importation, and later inquiries seem to indicate that it was invented by Dizé on the basis of previous work by Bryan Higgins, Méthérie and others; it is clear, however, that Leblanc first carried the process into successful practice, and the works which he established in partnership with the Duke of Orleans at St. Denis did well until this nobleman was decapitated in 1793 and the factory confiscated. The troubled state of France during this epoch was unfavourable to chemical enterprise, and Leblanc committed suicide in 1806. In due course, however, the Leblanc process became the standard method for manufacturing soda, and remained without a competitor until Solvay established the ammonia-soda process on an industrial scale at a small works near Charleroi in 1863. Solvay had supposed that his process, patented in 1861, was entirely novel; it transpired later that the physicist Fresnel had used it in 1811, and that D. H. G. Dyar and J. Hemming had obtained an English patent for it in 1838. Whilst these and other anticipations of novelty cannot be denied, it is clear that Solvay was the inventor in the sense that he was the first actually to succeed in establishing the process economically on an industrial scale.

The ammonia-soda process consists in carrying out the following reactions:—

1. $\text{NaCl} + \text{NH}_4\text{HCO}_3 = \text{NaHCO}_3 + \text{NH}_4\text{Cl}$.
2. $2\text{NaHCO}_3 = \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}$.

A consideration of the technical aspects of the reactions involved in the Leblanc and the Solvay processes at once reveals a difference in type. It transpired ultimately that no vast economy in cost of manufacture accompanied the transition from the Leblanc to the Solvay process; the former, however, necessitates an intricate organisation for dealing economically with the auxiliary products, whilst the latter is to a large extent self-contained in that the ammonia and carbon dioxide concerned can be re-absorbed in the cycle of manufacturing operations. The tenacity of life exhibited by the Leblanc process in face of the attacks of its new competitor is largely attributable to the commercial and technical skill which were exercised, particularly in this country, in dealing with the by-products. In the end, the Solvay process yielded some 95 per cent. of the world's production of soda; at the present moment, it is in course of replacement by a newer process based upon the electrolytic decomposition of sodium chloride.

Whilst struggling to establish his process Solvay became acquainted in 1872 with Ludwig Mond, who

was about his own age, and who, in partnership with the late Sir John T. Brunner, purchased the Winnington Park Estate at Northwich from the late Lord Stanley, and installed the ammonia-soda process; the situation of the new works was chosen with a view to the utilisation of the Cheshire salt brines. The Solvay process became a success, and is now in large-scale operation all over the world; from its production of about 3500 tons in 1872, it achieved an output in 1903 of 1,600,000 tons out of the 1,700,000 tons which represented the whole world's production. Naturally much had to be done to perfect details connected with the process, and it is interesting to note the recurrence in the history of the Solvay process of many names, such as Brunner, Mond, Tennant, Gossage, Deacon, Muspratt and James Young, which are inseparably associated with the development of the heavy chemical industry in Great Britain.

Notwithstanding his unorganised scientific education and the absorbing character of his industrial activities, Ernest Solvay was a person of wide sympathies, intensely interested in the higher developments of scientific thought and philosophy and incessant in his efforts to promote the material and intellectual progress of the whole world. The great war came as a great shock to the views which he had formed from contact with men of all nationalities as to the manner in which the future development of civilised humanity was to proceed. The great wealth which accrued from his industrial enterprises enabled Solvay in his later days to furnish very material support to many causes which he held very dear. In August, 1914, when the necessities of modern warfare led the Germans to remove what was of great value from, or to destroy the contents of the unique library, and to pillage the collection of medals of the Royal Academy of Belgium preserved in the Palais des Académies at Brussels, Solvay provided the funds which were required to keep in being the premier organisation of an intellectual character in Belgium. He was keenly interested in what he termed the problems of life and of social questions; he published many pamphlets from 1892 onwards on these matters, notably on "Le rôle de l'électricité dans les phénomènes de la vie," "Le comptabilisme," "Le productivisme social," and "Notes sur des formules d'énergétique physio- et psycho-sociologique." In 1893, during the revision of the constitution of Belgium, he was elected to the Senate by the Liberal Party; in 1897 he was again elected, and his speeches in the Senate on labour, death duties and just modes of taxation attracted great attention by reason of their breadth of outlook and their intense human sympathies. His desire to promote scientific development led him to found and to finance a number of institutions in Brussels for the promotion of scientific effort; he established the Solvay Society of Brussels and the Solvay Institutes of Physiology, Sociology, Physics and Chemistry. The Solvay International Institute of Physics was inaugurated in 1912 with the aid of a capital of 1,000,000 francs, to be expended by 1949, for the purpose of assisting the development of physical science, partly by defraying the expenses of research workers, partly by the holding of periodical conferences at which some twenty-five eminent physicists should discuss the larger physical problems. Several such conferences have been held and the verbatim reports of the meetings are of the utmost interest. An analogous chemical foundation was established under similar conditions in 1921, with a capital gift of 1,000,000 francs, and its first meeting was held in the Solvay Institute at the Parc Leopold, Brussels, in April of this year, M. Solvay himself being present at the discussions.

Although Ernest Solvay was of a very retiring disposition and shunned publicity, he received many well-deserved honours. The present King of the Belgians appointed him a Minister of State and a Grand Commander of the Order of Leopold; he received the Lavoisier Medal of the French Institute and the grand medal of the University of Paris. He was a Chevalier of the Legion of Honour, a corresponding member of the French Academy of Sciences, and an honorary member of the American, Dutch and French Chemical Societies and of the Royal Institution of London. He was an honorary member of the administrative council and a doctor, *honoris causâ*, of the University of Brussels. It may be noted that he was an ardent mountaineer; at the age of 65 he repeated his previous ascents of Mont Cervin, and when 68 years old crossed the Grépon in the Charmoz group of Mont Blanc.

W. J. POPE.

THE HOME DYESTUFFS INDUSTRY.

E. F. ARMSTRONG.

Questions relating to the home dye industry are still being actively discussed in both chemical and political circles. The machinery set up under the Dyestuffs Act, in particular the Licensing Committee, which has now been at work for 15 months, has had time to get properly into motion, and the moment appears opportune to attempt a review of the present situation from a standpoint as free as possible from bias, but yet representative of the views of the chemical community. An open letter, dated May, 1922, addressed by Mr. James Morton to his friends the Free Trade Members of Parliament will serve as a peg on which to hang the discourse. Mr. Morton's credentials are well known; as a colour-user before the war he produced fabrics and carpets of great beauty and artistic merit, using dyestuffs of which fastness to light was the outstanding quality. During the war he set out to produce these colours himself with a courage and an enthusiasm which both deserved and commanded success. To-day, having made his venture, he finds the present doubtful and the future uncertain. Mr. Morton's personal efforts, ably backed by a loyal band of technical workers, have resulted in the preparation of a certain class of essential colours, in quantity equal to the total demands of the country, and in quality even surpassing the pre-war standard; no British dyemaker has had higher standards.

Mr. Morton attributes the present troubles to the disastrous consequences of the Sankey judgment, and there can be few who will deny that no legal decision has been more productive of injury to British trade and of unemployment in the chemical, textile and allied industries. He is, however, more concerned with the future. The pledge given by the Government and by the nation to make our dyestuff industry independent of the foreigner is beyond denial, but the mistakes made within the industry, not the least of which are the obvious signs of internal dissension, and the very widespread opposition to the measure, must make the fulfilment of the pledge, in letter and spirit, very difficult to a Coalition Government.

The criticisms of the Dyestuffs Act arise from a variety of causes. The most loudly heard are probably those inspired by the merchant of German and other foreign dyewares. These, though quite understandable, should not be regarded seriously in any quarter. More weighty are the objections of those to whom any form of protection or prohibition is politically anathema. Objections on the score of

price can be dismissed at once as shortsighted; nothing is more certain than that if a German monopoly were to be re-established here prices would rapidly rise again. It must be remembered that whereas before 1914 there was some competition between opposing groups of German dyemakers, to-day there is none; the "I. G." embraces the whole of the German firms. Once the home industry has been set on its feet low prices will be entirely a question of bulk production; the dye industry will be far too much in the limelight to be able to relax its efforts to produce economically. Far more serious in the long run are criticisms based on quality, both as regards standard and variability. The colour-maker must set quality and reliability above all else.

In the past German manufacturers set great store on their methods of instructing the consumer how to use each particular colour. This practice is to-day widely adopted in America in a variety of industries under the name "service systems." The manufacturer seeks to acquire all possible knowledge about the application of his products, and to place this at the disposal of *bonâ fide* customers. These in turn are often willing to let others inspect their plants, and hence a tendency arises to pool all available information, and the user who is most willing to learn has most to gain from the pool. This procedure certainly results in the greatest gain to the community, and is surely much preferable to the system by which each user works in secrecy and repeats the mistakes of his neighbour.

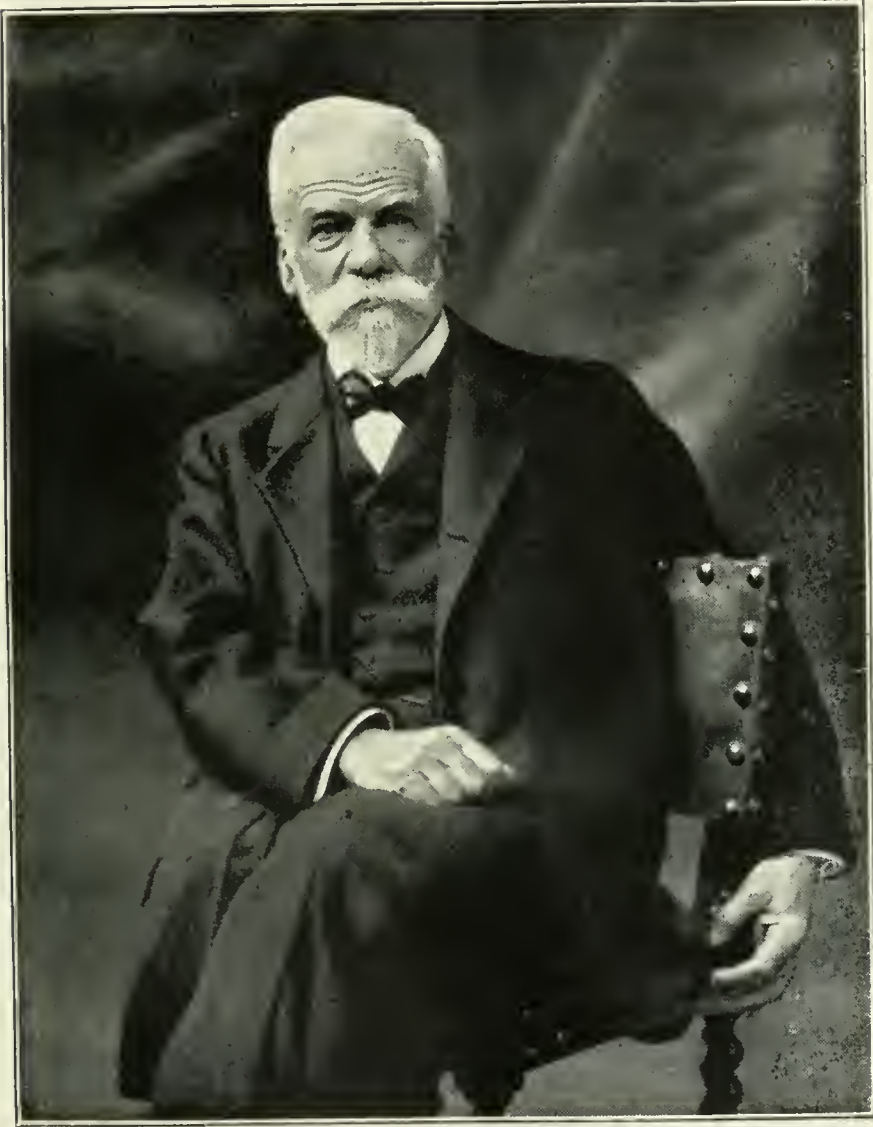
From the point of view of the chemist, which indeed most requires ventilating in this *Journal*, the chief criticism is that concerning technical control. Whilst nobody denies the progress made by the colour-makers in general, and that of individual firms in particular, colours were made and used before 1914, and it is generally felt that much more might be done, and that much of the development has been on unsound lines. Unfortunately, much capital has been spent unproductively, so that unless drastic writing-down is resorted to, the products will have to bear the burden of heavy overhead charges.

The most prominent factor in the German success has been the leadership of technical and technically-trained men. Much has been written and said to discredit the commercial methods of the German firms, but it is false policy to lose sight of the outstanding fact that technically their achievements were of the very highest order, and that the technical men had the chief, if not the sole, voice in their broad policy.

It is difficult to bring home to the lay mind what every chemist feels, namely, that the colour industry differs from all others in being essentially a scientific industry, and that its control must be largely in the hands of men who combine commercial ability with an intimate knowledge of the problems of the chemical industry and the faculty of leadership; this does not necessarily involve a profound knowledge of the chemistry of the dyes themselves.

Broadly, the problem is to make relatively small quantities of a large number of dyes in a state of reasonable purity from intermediates derived from the products of coal-tar distillation, and to sell these to the consumer at a fair price, at the same time showing him how to use the dyes to the best advantage. The actual consumption of many dyes about which outcry is made is too small to warrant their manufacture in Britain for Britain only; in other words, an export as well as a home trade has to be established. In the world's markets the products have to be sold on their merits.

The raw products of the colour industry are derived from the tar-distiller and the two trades should be so correlated that the colour industry



ERNEST SOLVAY.

is never in danger of going short of, or having to pay an excessive price for, its raw material. Some of the heavy chemicals, *e.g.*, acids, have to be made by the colour industry to save transportation charges. The design of this section of the factory and of the section for making intermediates requires technical ability and experience of the very highest order, as is witnessed by the great factory at Leverkusen, and its working requires highly scientific control; that we possess the necessary ability is fully demonstrated by what has been so far accomplished.

The actual manufacture of the dyes is really large-scale laboratory work, and success involves building up a chemical labour force equal to that possessed by Germany—largely a question of time and leadership. To the writer this is one of the great reasons for selecting a scientifically-trained technical man to control the works, as a mere "business man" will never appreciate the point of view of the chemist, or instil the necessary morale into his subordinates.

The appreciation of the necessity for maintaining quality, the prevention of waste, the utilisation of by-products along lines which are legitimate extensions of the dye industry, are the factors which ultimately regulate the "dividend" earned, and which demand the employment of men with a broad grip of the subject. Care must be taken, however, to avoid frittering away the energies of the staff and the resources of the firm on side lines; the main object—to make dyes—must be steadily pursued.

The research side of the industry speaks for itself; no word is more abused, no subject less understood by the lay mind. So far, both the British and American colour industries have in the main sought to re-discover the German methods; they will have to do far more than this if they are to hold their own in the future.

The "service" side of the industry needs to be developed to its utmost. Its problems will come to it from every industry which uses colour, and will be most varied, demanding a large equipment and an able staff. The "sales" side will have to be closely in touch with this branch and possessed of a good deal of technical knowledge. The sales force must be, in fact, quite different in type from the ordinary traveller.

This brief outline shows that the problems are quite dissimilar from those of the ordinary manufacturing business, where the commercial side—buying and selling—plays so large a part; they are chemical throughout, and their solution demands men with broad scientific and industrial training.

THE FERTILISER INDUSTRY IN THE UNITED STATES.*

J. G. LIPMAN.

Under normal conditions the consumption of artificial fertilisers in the United States is equivalent to about 7 million long tons (6,727,000 metric tons); in 1920 it reached a maximum of more than 7½ million tons, but in 1921 it fell to less than 5 million tons, owing to the severe economic depression in the most important of the fertiliser-consuming regions, namely, the cotton belt. With the restoration of normal conditions the consumption will increase again and will ultimately expand at the rate of 5 to 10 per cent. a year:

The fertiliser industry in the United States represents an investment of several hundred million dollars. The census of 1919 shows that the farmers of the United States expended in that year \$329,189,912 on commercial fertilisers. This represents a purchase of nearly 7 million tons of materials. There existed in that year more than 800 fertiliser-manufacturing establishments, and about 75 per cent. of these produced fertiliser as a primary product. Of the entire tonnage consumed, South Carolina, North Carolina, and Georgia use in a normal year considerably more than 3 million tons. Virginia, Alabama, Mississippi and Tennessee are also important users. All told, the Southern States have used in the past as much as two-thirds of the entire fertiliser tonnage of the United States, most of which has been used for the cotton crop. Apart from the present economic depression, the spread of the boll weevil, one of the most costly of our insect enemies, in recent years has disorganised the cotton-growing industry, and, therefore, also the fertiliser industry. The failure to control the boll weevil is bound to react disastrously on the manufacture and distribution of artificial fertilisers in the United States.

There are two other important fertiliser-consuming regions. One of them, the Middle Atlantic States, including New York, New Jersey, and Pennsylvania, may be expected to consume normally about 1 million tons. The North-East Central States, consisting of Ohio, Indiana, Illinois, Michigan, and Wisconsin, represent a consumption of 700,000 to 800,000 tons, and the New England States, comprising Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut, about 400,000 tons. Of the Pacific Coast States only California has any considerable tonnage. Since the present trend of agriculture in the United States is towards the production of larger crops per acre, the most marked increase in the demand for fertilisers should come from certain of the Western States, notably Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Missouri, and Kansas.

A large proportion of the entire tonnage not used in the cotton belt is employed in the production of potatoes, sweet potatoes, vegetables, maize, tobacco, and forage crops. In some sections of the United States artificial fertilisers are depended upon almost entirely for the production of large crops of potatoes, tobacco, vegetables, and tree fruits. For instance, the State of Maine uses annually about 150,000 tons of fertilisers, of which but a small proportion is employed in the growing of crops other than potatoes. In New Jersey 40 to 45 per cent. of the entire tonnage is used by potato growers. Large quantities of superphosphates are employed by growers of maize in Ohio, Indiana, New York, and Pennsylvania. There is also a marked tendency to use more liberal amounts of nitrogen and of potash in many sections of the United States for the production of cereals and other staple food crops.

Sources of Fertiliser Materials.

Phosphate rock and sulphuric acid are quantitatively by far the most important of the fertiliser ingredients. Two to two and a half million tons of phosphate rock and approximately the same quantity of sulphuric acid (50° Bé.) are employed to produce 4 to 5 million tons of superphosphate. Florida supplies most of the phosphate rock used for this purpose. Tennessee and Kentucky furnish half a million tons or less, whilst smaller amounts are furnished by South Carolina and the western deposits in Idaho, Utah, Wyoming, and Montana. It is estimated by competent authorities that Florida contains about 227 million tons of phos-

*A Paper read before the Chemical Industry Club (London) on May 24, 1922.

phate rock of good quality, Tennessee 88 million and Arkansas 30 million tons. At the present rate of consumption the time is evidently not very distant when the phosphate deposits of Florida and Tennessee, as well as the smaller deposits in Arkansas and Kentucky, will be exhausted. Fortunately for the United States, enormous deposits of high-grade phosphate rock have been located in the States of Idaho, Utah, Wyoming, and Montana. Investigations thus far made by the United States Geological Survey indicate in these States the existence of deposits of more than 6 billion tons of high-grade rock and a very much larger quantity of lower-grade phosphate.

Among the other ingredients used in the industry mention should be made of tankage, dried blood, ground bones, hoofs and horns, dried and ground fish, and cottonseed meal. The great slaughtering establishments in Chicago, Omaha, Kansas City, and elsewhere contribute in an important way to the supply of nitrogen and phosphorus used in artificial fertilisers. Tankage is derived from meat scraps, carcasses of dead and condemned animals, bones, intestines, etc. These materials are cooked in specially constructed tanks. After the removal of the fat, the residue is passed through a filter-press, dried, ground, and sold under the name of "tankage." It is a meal of brownish colour containing varying amounts of nitrogen and phosphorus. The standard grades of tankage contain 7.5 to 9 per cent. of nitrogen and 12 to 20 per cent. of tricalcium phosphate. The largest producers of tankage are the Armour Fertiliser Works, Swift and Company, Wilson and Company, and the Cudahy Packing Company. A survey of the packing industry made in 1918 showed a production of more than 350,000 tons of animal fertilisers. Of this more than 200,000 tons consisted of high-grade tankage and about 60,000 tons of low-grade tankage. There was, likewise, a production of more than 35,000 tons of dried blood and of about 55,000 tons of bones.

The fishing industry is another important contributor to the fertiliser resources of the United States. The Atlantic and Gulf Coasts are the principal domestic sources of dried and ground fish. About 50 fish-scrap factories are scattered along the Atlantic coast from Maine to Port Arthur, Texas. Most of these are found in the region of Chesapeake Bay. The menhaden is the principal of the fish varieties used for the making of fish guano. This fish, which travels in large groups or schools, is caught in nets carried by small boats. The fish is transferred from the nets to a steamer and unloaded into large storage bins at the factory. From these it is automatically conveyed to the cooker, where it is treated with steam for about twenty minutes. The cooked fish is fed into a power press, which squeezes out the water and oil. The residue, known as scrap, is placed in a hot-air dryer and later ground. Dried fish-scrap made from menhaden usually contains about 7 to 9 per cent. of nitrogen and 14 to 16 per cent. of tricalcium phosphate. In 1918 the catch of fish-scrap was equivalent to more than 50,000 tons, but in 1919 and 1920 it was somewhat smaller.

Cottonseed meal is still used very extensively for fertiliser purposes. Since it is, in a sense, a by-product in the growing of cotton, its supply necessarily varies with the size of that crop. For instance, in 1914 the cotton crop was equivalent to about 16 million bales, or much larger than the normal crop of 10 to 12 million bales per annum. On the other hand, in the disastrous year of 1921 the production fell very much below the normal and the supply of cottonseed meal for fertiliser and feeding purposes was correspondingly decreased. The estimated production of cottonseed meal and

cake under normal conditions is between 1½ and 2 million tons. The proportion of this supply available for fertiliser purposes depends on the cost of maize; when maize is cheap a relatively larger amount of cottonseed meal is used as fertiliser, but when the price is high a relatively larger proportion of the meal is used for feeding domestic animals. After the cottonseed has been crushed and the oil extracted, the residue, known as cottonseed meal, contains 4 to 8 per cent. of nitrogen, about 2.88 per cent. of phosphoric acid, and about 1.77 per cent. of potash. As a fertiliser it gives most satisfactory returns when used in warm soils and for crops that have a long-growing season, particularly cotton and tobacco. In the report on the fertiliser industry of the United States, published by the Federal Trade Commission in 1916, it is stated that more than one-half of the cottonseed meal produced in North Carolina, South Carolina, Georgia and Alabama is used for fertiliser purposes. Of the entire amount of cottonseed meal produced in all of the cotton-growing States about two-thirds is used for the feeding of livestock and about one-third as fertiliser. In recent years there has been a tendency to use more and more of the cottonseed meal for livestock feeding and less of it as fertiliser. Nevertheless, even at the present time a very large quantity is applied to the land.

Of other fertilisers, sodium nitrate and ammonium sulphate are the most important sources of nitrogen. The imports of nitrate of soda into the United States have shown wide fluctuations in recent years, largely on account of the war. Prior to 1913 the imports of nitrate of soda into the United States varied from about 500,000 to 600,000 tons. In 1916 the imports were well above one million tons, and in 1918 nearly 1,900,000 tons. In 1919 the imports fell to less than 325,000 tons, and rose again to about 1.25 million tons in 1920. The production of sulphate of ammonia has steadily increased in the last ten years. In 1905 the domestic production was about 65,000 tons, in 1910 it was 116,000 tons; in 1915, 212,000 tons, and in 1920 somewhat less than 500,000 tons. Under present conditions the United States has, therefore, an exportable surplus of sulphate of ammonia. In the manufacture of sulphate of ammonia, as in the manufacture of superphosphates, sulphuric acid is used in large quantities. Formerly the sulphur for the manufacture of sulphuric acid was obtained from pyrites, principally from that imported from Spain. The consumption of pyrites has materially declined, for brimstone has taken its place in large measure in the manufacture of sulphuric acid. In 1919 the domestic production of pyrites in the United States was about 400,000 tons, whereas in 1920 it was approximately 100,000 tons. The imports from Spain were equivalent in 1920 to about 200,000 tons, and those from Canada to about 100,000 tons. This does not compare favourably with the former consumption of pyrites in the United States, which exceeded one million tons per annum throughout the period 1910 to 1917, and reached the high figure of 1,712,819 tons in 1916. On the other hand, the production and consumption of sulphur in the United States have steadily increased. According to estimates of the United States Geological Survey, the production of crude brimstone in the United States during the period 1880 to 1901 was less than 8000 tons a year. During the period 1902 to 1906 the Frasch process was applied to the extraction of sulphur from the Louisiana deposits. In 1906 the production increased to 300,000 tons; by 1915 the output was more than 500,000 tons; in 1917 more than one million tons, and in 1920, 1,650,000 tons. Also the capacity for the production of sulphuric acid has steadily expanded. On the basis of 50° Baumé acid, the production in 1889 was less than 800,000

tons. In 1899, or ten years later, it was about 1·5 million tons; in 1909 it was 2·75 million tons and in 1919 more than 5·5 million tons. Much of the sulphur is used in the manufacture of paper pulp, of vulcanised rubber and of oil products, but its consumption in the fertiliser industry is very large indeed. The larger deposits of sulphur are now controlled by the Union Sulphur Co., whose deposits are located in Louisiana, and by the Freeport Sulphur Co and the Texas Gulf Sulphur Co., whose deposits are in Texas. The Texas Oil Co. is reported to have recently discovered large additional deposits of sulphur. The deposits controlled by these companies are very large and, owing to the economical methods used in extracting the sulphur, have come to play a leading rôle in the sulphur markets of the world. Available statistics show that in 1900, 95 per cent. of the world's supply of sulphur came from Sicily; in 1912 only 50 per cent. came from that source, and in 1917 only 14 per cent., whereas in the same year 80 per cent. of the world's supply came from the United States.

Apart from the use of sulphur for the manufacture of sulphuric acid, there has been a growing demand for finely pulverised sulphur for the dusting of fruit trees and of vegetables, but more particularly for the control of certain diseases, especially of the common scab of potatoes (*Actinomyces scabies*) and scurf (*Monilochaetes infusans* Ehn.). In certain sections of the United States, particularly in Oregon and Idaho, pulverised sulphur is used effectively for increasing the yields of lucerne. It is also being recommended for use as a means of reclaiming alkali soils in California and other States of the Pacific Coast, and likewise for controlling nematodes in the Southern States. There is likely to be an increasing demand for pulverised sulphur for the purposes enumerated above.

Prior to the war practically all of the potash fertilisers used in the United States were imported from Germany. In 1913 the importations consisted of about 202,000 metric tons of muriate, 33,000 tons of sulphate, 225,000 tons of double manure salts, 445,000 tons of kainit, and about 38,000 tons of other salts, making a total of about 943,000 metric tons of potash salts containing an equivalent of about 228,500 metric tons of actual potash, all of it intended for agricultural uses. During the war the importation of German potash was discontinued and the production of domestic potash given a powerful stimulus. The peak of domestic production was reached in 1918 when 128 plants produced nearly 208,000 tons of crude material, containing an equivalent of nearly 55,000 tons of actual potash. In 1919 the effect of foreign competition was already beginning to be felt. At the end of that year 102 plants reported production during the year, and the total output fell to less than 32,500 tons of actual potash. In 1920 only 66 plants reported production, and in 1921 most of these had closed down. Of the domestic plants that were in operation during the war period these located in Nebraska, and deriving their salts from small lakes and ponds, contributed the largest proportion. The Searles Lake district in California was another important source of potash, and smaller quantities were derived from cement mills, blast furnaces and sugar refineries. Considerable quantities of potash were also obtained from alunite and from kelp.

Since 1919 the volume of imported potash fertiliser has again increased to large proportions. Thus, in 1919, there were imported into the United States less than 30,000 tons of actual potash. Of this quantity 18 per cent. consisted of kainit, 22·9 per cent. of manure salts, 29·2 per cent. of muriate, 1·8 per cent. of sulphate, and the remainder in the form of other potash compounds. In 1920 the imports were equivalent to nearly

200,000 tons of actual potash. About one-quarter of this was in the form of kainit, and about 30 per cent. each in the form of manure salts and of muriate of potash. Of the imported potash by far the largest proportion is derived from German mines, but the importations from the Alsatian mines are considerable and of quite satisfactory quality.

The Manufacture of Artificial Fertilisers.

There are two distinct steps in the manufacture of artificial fertilisers in the United States. One of these concerns the production of superphosphates; the other deals with the mixing of superphosphate with nitrogen and potash-bearing materials in order to create the so-called "complete" fertilisers containing the three ingredients, nitrogen, phosphorus and potassium. In the manufacture of superphosphate certain low-grade nitrogenous materials, such as leather waste, hair waste, wool, etc., are often mixed with the ground phosphate rock and the mixture treated with sulphuric acid. The resulting product is known as "base goods," or ammoniated superphosphate. It contains from 1·5 to 2 per cent. of nitrogen and about 16 per cent. of phosphoric acid. In fact, most of the superphosphate sold in the United States contains 16 per cent. of citrate-soluble phosphoric acid. The ammoniated superphosphate, or non-ammoniated superphosphate, is mixed with other ingredients to form the different brands of mixed fertiliser. This represents the bulk of the artificial fertilisers used in the United States. For instance, a survey made in 1918 showed that about 3·5 million tons of acid phosphate and about 0·5 million tons of base goods were mixed with other materials to produce more than 5·5 million tons of so-called complete fertilisers. Among the more important substances used in these mixtures were sodium nitrate, ammonium sulphate, tankage, garbage tankage, dried blood, fish scrap, castor-bean pomace, natural guano, and a very large number of other materials of minor importance. Apart from these there were also different materials known as fillers—among them finely-ground peat, ground limestone and garbage tankage.

Many of the brands are distinctly low-grade, as, for instance, a mixture corresponding in analysis to 1—8—1, an equivalent of 1 per cent. of ammonia, 8 per cent. of phosphoric acid, and 1 per cent. of potash. This represents a total of ten units of plant-food. Much of the fertiliser sold in the grain-growing sections of the Middle West corresponds in composition to a 2—8—2, or 12 units of total plant-food. There is now a movement on foot among the fertiliser manufacturers in the United States to encourage the use of "high-analysis" fertilisers. The definition of a high-analysis fertiliser is one containing 14 units or more of plant-food. Among the popular brands of mixed fertilisers in the more intensively cultivated sections of the United States are those containing 4 to 6 per cent. of ammonia, 7 to 10 per cent. of phosphoric acid, and 3 to 7 per cent. of potash. Potato growers in the Eastern States demand mixtures containing at least 4 per cent. of ammonia, 8 per cent. of available phosphoric acid, and 5 per cent. of potash. Prior to the war potato-growers demanded mixtures containing 10 per cent. of potash. The tendency now is to limit the proportion of potash to 7 or 8 per cent.

Both the manufacturers of mixed fertilisers and the agricultural experiment stations and control laboratories lay much stress on the character of the nitrogen found in the fertilisers. In the manufacture of the better grades an effort is made to derive some of the nitrogen from nitrate of soda or some other nitrate, part of it from sulphate of ammonia or other ammonium salts, and part of it from animal or vegetable sources. Prior to the war the average

of the mixed fertilisers sold in the United States contained about 2.5 per cent. of nitrogen, of which one-half was derived from animal and vegetable sources, and about one-quarter each from nitrates and ammonium salts.

Contrary to European practice, the manufacturers of artificial fertilisers in the United States still use relatively large amounts of nitrogenous materials derived from animal and vegetable sources. In part this may be attributed to the policy of the meat-packing establishments to find a good outlet for certain of their waste products. Some of the big companies, like Armour and Co. and Swift and Co., have, therefore, gone into the fertiliser business and are utilising their tankage, bone meal, horn and hoof meal, dried blood, etc. for the manufacture of mixed goods. A more important reason lies in the necessity for providing mixed fertilisers that remain in a dry, powdery condition for a long time. Usually the mixtures are made up in the winter or very early in the spring, many weeks before the farmers are ready to apply them. Since most of the fertiliser used in the United States is distributed by means of fertiliser drills or other distributing machinery, the farmers would reject any fertiliser that tends to harden or cake in the bag. This circumstance has induced the manufacturers to employ so-called conditioners or driers, particularly those of an animal or vegetable character. Conditions of demand and supply are, therefore, giving a value to these materials entirely out of proportion to their true agricultural value. It has been well established, for instance, that the efficiency of nitrogen in nitrates and in ammonium salts is much greater than that in animal or vegetable substances. Nevertheless, the nitrogen in the latter costs much more than that in nitrogen salts. In fact, nitrogen in tankage or fish often costs twice as much as nitrogen in nitrates or ammonium salts.

The more important manufacturers of fertilisers, particularly the Virginia-Carolina Chemical Co., the American Agricultural Chemical Co., Armour Fertiliser Co., and F. S. Royster Guano Co., have large plants equipped fully with labour-saving devices. The unloading of raw materials, the grinding of phosphate rock, the acidulation of the phosphate rock, the removal of the superphosphate from the bins and its grinding, the mixing of other materials with superphosphate, the weighing, bagging and loading on the cars are largely done by means of automatic machinery. The cost of manufacture and handling is, therefore, reduced to a minimum. On the other hand, the larger manufacturers have high administration and high sales costs as well as large capitalisation, involving high interest charges, large depreciation of the plant, etc. It should also be noted that much of the business done by the larger fertiliser manufacturers is on a credit basis. Farmers are allowed six months or a full year in which to pay their bills. The fertiliser manufacturers are, therefore, bankers as well as manufacturers. In times of economic depression, like that of 1921-22, the fertiliser manufacturers are unable to collect their debts, and, for this reason, are obliged to borrow large sums of money in order to maintain their business. This adds very materially to the cost of artificial fertilisers. The smaller manufacturers are at present in a more fortunate position. Many of them are so-called *dry-mixers*, that is, they do not manufacture their own superphosphate, but obtain it in the open market and add the other ingredients for the production of complete fertilisers. Their overhead and sales costs are low, and their losses due to bad debts relatively small. They are, therefore, able to do business on a smaller margin of profit. Of late years these dry-mixers or smaller manufacturers have been able to undersell the larger

manufacturers. The economic situation is still further complicated by the fact that the co-operative movement among the farmers in the United States is growing very fast. Groups of co-operators are beginning to buy large quantities of fertiliser materials and are doing their own manufacturing. The question has, therefore, been raised whether the large fertiliser manufacturers will be able to hold their own under the stress of changing conditions.

Within the past four or five years the higher transportation and labour costs have compelled the fertiliser manufacturers to study their problem more critically. The national organisation of fertiliser manufacturers, known as the National Fertiliser Association, through its educational bureau known as the Soil Improvement Committee, has initiated educational work on behalf of the higher-grade fertilisers. They have realised that the low-grade mixtures are too costly from the standpoint of labour, transportation, sales and administration. The farmers' organisations are also appreciating this fact and are showing distinct preference for mixtures with a higher content of actual plant-food. This tendency is strengthened by the recent introduction of more concentrated and more soluble substances manufactured for fertiliser purposes. Not many years ago the standard acid phosphate in the United States contained 14 per cent. of available phosphoric acid. Now it is the 16 per cent. acid phosphate that is more common. Some of the manufacturers are making 17 and 18 per cent. acid phosphate. The Anaconda Copper Co., in Montana, in order to find an outlet for its by-product sulphuric acid, is making a double superphosphate containing 45 to 48 per cent. of available phosphoric acid. The American Cyanamid Co. is manufacturing an ammonium phosphate which contains about 11 per cent. of nitrogen and 48 per cent. of phosphoric acid. The introduction of ammonium nitrate, urea, and of other more highly concentrated fertiliser materials is certain to hasten the movement towards the manufacture and use of more concentrated materials. This, in its turn, will compel improvement in the machinery used for the distribution of fertiliser and also greater care on the part of the farmers in the use of chemical manures.

The Future of Artificial Fertilisers in the United States.

In attempting to forecast the further development of the manufacture and use of artificial fertilisers in North America, one must take into consideration certain clearly defined factors. It is evident, in the first place, that under normal conditions the consumption of fertilisers is certain to increase rapidly. It is obvious that the American farmers are learning to appreciate the value of availability and concentration in fertilisers. The use of inert fillers will be reduced to a minimum. There will be a tendency to employ basic mixtures containing small proportions of nitrogen and potassium and a high proportion of available phosphoric acid. These will be supplemented by additions of nitrogenous materials like nitrates, ammonium salts and their derivatives, and also by the addition of potassium salts, as the soil, crop and seasonal conditions may warrant. On the part of the manufacturers advantage will be taken of new discoveries in chemistry. The manufacture of phosphoric acid by means of the electric furnace is already now approaching a commercial stage. When this material is made in large quantities the use of sulphuric acid for the making of available phosphoric acid will be gradually but, nevertheless, surely restricted. The double superphosphates will become one of our chemical staples, and their manufacture will permit the utilisation of certain types

of phosphate rock which are not now suitable for the manufacture of superphosphates. The animal and vegetable products now used in the fertiliser industry will also gradually lose their importance, and will be consumed more largely for the feeding of livestock. The consumption of potash salts will gradually increase, and an effort will be made by American potash producers to hold the market against foreign competition. There are even now several American potash producers who claim that in time they will be able to hold their own against potash imported from Germany or France. The development and improvement of the processes for the fixation of atmospheric nitrogen will reduce the cost of this ingredient, and will have a marked tendency to encourage the use of larger amounts of it. Students of soil fertility in the United States recognise that the consumption of nitrogenous fertilisers is too low at present, and is not in keeping with the most economical methods of food production. At present the American farmer is growing on the average 30 bushels of wheat on two acres, whereas the English farmer is growing 30 bushels of wheat on one acre. Under conditions as they have existed within the past 30 or 40 years it was more profitable for the American wheat-grower to produce 30 bushels on two acres even though, with proper methods, he could increase his yields, as has been done by farmers in some of the European countries. But increasing transportation costs, higher land values, and the increasing density of the population in certain regions will compel more intensive methods, which means the use of larger quantities of nitrogen and potassium per acre.

It may be said that the fertiliser industry in the United States is at present in a state of flux. The increasing output of by-product ammonium sulphate and the creating of an exportable surplus of this commodity, the uncertainty as to the fate of the large cyanamide plant at Muscle Shoals in Alabama, the importation of calcium nitrate, ammonium nitrate and sodium nitrate from Norway, the development of the Claude process, all have a bearing on the present fertiliser situation. Certain of the zinc and copper smelters are being compelled by recent legislation to avoid polluting the atmosphere with sulphur fumes. They must, therefore, manufacture sulphuric acid. Enormous quantities of acid are thus produced by the Anaconda Copper Co. in Montana, by the Tennessee Copper Co. in Tennessee, as well as by other companies. This, naturally, makes for the utilisation of a large part of the by-product sulphuric acid in the manufacture of superphosphates. A large quantity of sulphuric acid after use in the refining of petroleum is also available for the manufacture of superphosphates. This by-product acid must be utilised somehow. Hence, a large volume of superphosphate is produced and often offered for sale at a very low price. We must, likewise, reckon with the question of foreign competition as it affects the American manufacturer of fertiliser materials. Thus, the American potash manufacturers are well organised and are bringing much pressure to bear on Congress to place a duty on imported potash. Similarly, the producers of ammonium sulphate are clamouring for a duty on imported nitrogen. On the other hand, the great body of the American farmers is opposed to any tariffs on plant food. The question is, therefore, not only an economic one but in part also a political one. All things considered, it is safe to state that in the rapid future expansion of fertiliser-consumption in the United States new methods of manufacture, the introduction of new fertiliser materials, the devising of more practical fertiliser-distributing machinery and the more skilful use of artificial fertilisers, are certain to play a large part in the agricultural practice of the country.

THE SAFEGUARDING OF INDUSTRIES ACT.

SYNTHETIC CAMPHOR.

The complaint that synthetic camphor was improperly included in the list of dutiable articles was heard by the Official Referee, Mr. Cyril Atkinson, K.C., on April 1 and 29, and his decision was circulated at the end of last month. The inquiry centred around the term "synthetic" in its relation to the form of camphor which is manufactured from pinene through isoborneol or camphene, and which differs from natural camphor only in being optically inactive. This form of camphor is manufactured in large quantities in Germany, where it is known as synthetic camphor, and according to recent advices it has almost entirely replaced natural camphor for technical use in that country. During the war its medicinal value was proved to be equal to that of natural camphor. For the purpose of this inquiry, the substance was called by the complainants "turpentine" camphor to distinguish it from "artificial" camphor, which is another name for pinene hydrochloride, and from the product synthesised (admittedly) by Komppa (via camphoric acid), which is not an article of commerce.

Sir A. Colefax, K.C., who appeared for the complainants, the British Xylonite Co., Ltd., contended (1) that the Act did not apply because camphor was not manufactured in this country, and that the imposition of a duty injured an existing industry, viz., the celluloid industry; (2) that camphor artificially produced was no more a chemical than soap, or starch, or water; (3) that if it were adjudged a chemical, it was neither a synthetic chemical nor a fine chemical.

Mr. Whitehead, for the Board of Trade, maintained (1) that the so-called "turpentine" camphor was a synthetic compound in the modern acceptance of that term; it was, for example, as much synthetic as Wöhler's urea produced from ammonium cyanate; (2) that it was a chemical, being a prepared product and its use being based upon its reactive properties.

Mr. C. P. Merriam, joint managing director of the complainant company, said that his firm employed 2400 people before the war, and now about 1800; he believed that the British Xylonite Co. was the only one manufacturing celluloid in this country. No "turpentine" camphor was at present used in the manufacture; in 1906, 1907, 1908, 1909 the proportion of it to natural camphor had been 26, 34, 30, and 9 per cent., respectively. It had been made in this country by three firms, of which two were unable to produce the right article, and the third could not withstand competition; all three had been liquidated. The obstacle to home manufacture was the use of the monopoly held by the Japanese Government in driving down prices when competition rendered such a course desirable from the standpoint of the producers of natural camphor. Since the conclusion of the war his firm had spent over £10,000 in experimental work, and it had been found that the manufacture here, though technically feasible, was economically impracticable. In the United States the Du Pont de Nemours Co. had started the manufacture, but had, he said, abandoned it. He had not purchased "turpentine" camphor since last autumn, but the effect of the Act would be to make the Japanese Government raise the price of natural camphor by the amount of the duty imposed. In 1913 his firm expended £101,000 in the purchase of natural camphor. So-called "artificial" camphor (pinene hydrochloride) was useless for making celluloid. The price of "turpentine" camphor, in September, 1921, was

280s. per cwt., and that of natural camphor, in November, 1921, was 399s. per cwt.; before the war the natural product was cheaper, but when the supply ceased during the war the price of "turpentine" camphor increased sixfold.

Mr. F. Sproxton, chief chemist to the British Xylonite Co., disagreed with the view which the Board of Trade stated was held by some chemists—that any chemical action occurred in the manufacture of celluloid from camphor and nitrocellulose. Celluloid did not smell of camphor because in the seasoning process a skin formed upon it; when the skin was scratched with a knife the smell of camphor was at once perceptible. It was also not correct that camphor did not sublime from celluloid. The two substances were admixed or in solid solution, not chemically combined, and the camphor imparted to the nitrocellulose the mechanical properties of plasticity and toughness. In his opinion natural camphor was not a chemical; artificially-made camphor was, generally speaking, a chemical, though not to the celluloid manufacturer, to whom it was a constructional material. The same was true of nitrocellulose. A chemical was a substance prepared by a process involving change of composition, and used for processes involving such changes. For the manufacture of "turpentine" camphor a specialised plant was necessary, and two chemists would be required for every 30–40 workmen. Broadly speaking, no one except Schering, of Berlin, had succeeded in its manufacture; there was little difficulty in making an impure product; the difficulty, and the increased cost, lay in obtaining purity. The manufactured substance was usually less pure than Japanese "crude" (about 95 per cent.), and it would not be employed in making the best quality celluloid. A synthetic process was a process involving the building-up of a compound from its elements or from other compounds which could be produced from their constituent elements. The building-up proceeded methodically, in stages, and in the case of organic compounds involved an increase in the number of carbon atoms in the molecule. The preparation of vanillin from eugenol was not a synthetic process. When he suggested the use of the term "turpentine camphor" to designate true camphor prepared from pinene hydrochloride, he was unaware that the term was used in Germany to signify pinene hydrochloride.

Mr. E. J. Parry said that the only attribute of a chemical possessed by "turpentine" camphor was its preparation by a chemical reaction, and the only attribute it shared with a fine chemical was that it was difficult to obtain pure. By "synthesis" he understood the building-up of a compound from its elements, directly or indirectly, by orderly steps, the result of each of which could be accurately followed, and from which the constitution of the substance could be deduced. Practically every organic synthesis involved the addition of carbon atoms. The term "synthesis" was almost antithetic to "isomerisation," and it had no trade or industrial meaning. The relation of camphor to pinene was the same as that of vanillin to eugenol. It was true that phenol produced from benzene (with a like number of carbon atoms) was called synthetic phenol, and that many dyes, commonly called synthetic organic dyes, were prepared from compounds which had not been synthesised. He would not call camphor produced from pinene "synthetic" until pinene had been produced synthetically on a commercial scale; such production should be regarded as the criterion of the applicability of the term "synthetic" to an industrial product. He could not regard "turpentine" camphor as a chemical unless it were used industrially for chemically reactive purposes. Natural camphor was not regarded as a chemical in the trade; if it were admitted to be a chemical, only the first-grade

product could be called a fine chemical. Asked by the Referee if a manufactured substance, not known in Nature, were then to be found in Nature, would thereupon cease to be a chemical, Mr. Parry said that probably no chemist could answer that question at the present time. This witness also dealt with the classification of camphor in trade journals and in chemical literature, and Mr. Whitehead adduced evidence of the opposite kind.

Dr. M. O. Forster, who was the only witness for the Board of Trade, associated himself with the counter-statement put in by the Board, except in regard to the view that in the manufacture of celluloid, camphor and nitrocellulose react chemically. He disagreed with the view of synthesis put forward by previous witnesses, and said that in recent years the term had come to mean much more than building-up; to him and other systematic organic chemists it signified the step-by-step preparation of a compound, as distinct from haphazard artificial production; each step was controlled and provided, as a rule, evidence of the molecular structure of the substance produced. In answer to counsel, who asked if in the conversion of pinene into bornyl chloride it was possible to infer the constitution of the latter substance from the reaction *per se*, Dr. Forster said that it was not possible, but that in drawing such inferences the organic chemist had also to take cognisance of other facts and of the results of incidental tests. The word "synthesis" to-day was not restricted to cases of building-up; it was also used for reactions in which the numbers of carbon atoms in the initial and end-products were the same, or even less (degradation), and for cases of molecular rearrangement. In this connexion Dr. Forster quoted from "Synthetisch-Organische Chemie der Neuzeit," by Prof. Julius Schmidt (1908), who throughout this work uses the word "synthetic" to connote "the preparation of complex substances from simpler ones, or even for the totality of artificial methods of preparing such compounds." Among the methods described in this book and quoted by the witness as being correctly designated synthetic were:—(1) The transformation of suberic acid, $(\text{CH}_2)_4(\text{COOH})_2$, into hexamethylenediamine, $(\text{CH}_2)_6(\text{NH}_2)_2$; (2) the production of cadaverin, $\text{H}_2\text{N}(\text{CH}_2)_5\text{NH}_2$, from 1:5-dichloropentane, $\text{Cl}(\text{CH}_2)_5\text{Cl}$; (3) the preparation of chroman, $\text{C}_8\text{H}_8\text{O}$, starting from tetrahydroquinoline, $\text{C}_8\text{H}_{11}\text{N}$; (4) the transition from *d*-citronellol, $\text{C}_{10}\text{H}_{18}\text{O}$, to menthene, $\text{C}_{10}\text{H}_{16}$, and menthadiene, $\text{C}_{10}\text{H}_{14}$. Asked if he regarded camphor as a chemical, Dr. Forster said that it would be an outrage not so to regard it; it was one of the most chemically reactive organic substances known. "A chemical," he said, "is an individual substance brought into existence in accordance with the principles of chemistry, or taking part in changes involving these principles." According to this definition, both natural and artificial camphor were chemicals.

The decision ran as follows:—

The question in this case for me to determine is whether synthetic camphor is rightly included in the list of dutiable substances either as a synthetic organic chemical or as a fine chemical. It is necessary to describe clearly the nature of the substance I am considering. There is a synthetic camphor properly so called. It is a camphor produced by complete synthesis and is known as Komppa's. This synthesis is a purely laboratory process. The substance is not imported, and is not the substance referred to by the expression synthetic camphor found in the list. It is common ground that the synthetic camphor referred to is camphor produced by treating pinene with hydrochloric acid and oxidising the product camphene. It is said by the complainants that this substance is

not a chemical at all, and if it is, that it is certainly not synthetic. What is the meaning of synthetic? There is no dispute about the original meaning of the word. It meant the building-up of a compound from its elements or from such compounds as could be obtained from their elements. Probably that remains the strict academic definition. It is given by many writers of acknowledged authority, such as Richter and Schorlemmer. It was also given to me in evidence by Mr. Ballantyne, Prof. Howitt, and Prof. Rogers. But I am satisfied that its meaning has broadened, and I propose to take as the definition of the word the broadest definition which has received any general recognition or acceptance amongst chemists.

I do not think that I am justified in adopting a definition which has not received that general acceptance, and which is recognised only by comparatively few chemists. Dr. Forster agreed that the understanding of the term by the vast number of chemists to-day is a bringing together of elements or radicals to form a more complicated body. It seems to me that that is practically the same definition as that given by Sir Edward Thorpe. Sir Edward Thorpe's definition is a building-up of carbon compounds either from their constituent elements or from groups of differently constituted molecules. Mr. Parry and Mr. Foster Sproxton support that definition, and I do not see that I can be far wrong in adopting it when I have Dr. Forster's assurance that that is still the understanding of the term among the vast majority of chemists. One writer, Dr. Schmidt, has adopted a still wider meaning, namely, the totality of artificial methods of preparing complex compounds. So far as I know nobody else has gone so far. Dr. Forster explained how the word synthetic differed from the word artificial. He said that artificial meant haphazard production, whereas the word synthetic meant a following of each chemical step as it occurred, so that you kept control of the constitution at the intermediate stages. Dr. Forster's own view, while certainly differing in this respect from the extreme view of Schmidt, went considerably beyond that of Sir Edward Thorpe, and he told me, and, of course, I accept it, that his view was held by the leading systematic chemists. I think he put the matter in a nutshell. On the one hand is the extreme view held by the few, including himself; on the other hand is the view still held by the vast majority of chemists. The Board of Trade, in their ably drawn case, contend that I ought to accept the ordinary trade or industrial meaning, and submit that that meaning is, in fact, "produced by controlled processes resulting in molecular changes of any kind." The evidence shows that this meaning so far from being the ordinary one, is the meaning accepted only by the few. I have no evidence of any kind of an ordinary trade or industrial meaning, and the nearest I can get to that meaning is to accept, as I do, that of the vast majority of chemists.

I think that in all probability that is the meaning the Legislature had in mind. I think that the word synthetic, as used in the Act, means a building-up of carbon compounds either from their constituent elements or from groups of differently constituted molecules by orderly steps, the result of which can be followed, and from which the constitution of the structure can be deduced or inferred. So far as I can see, there is no doubt that synthetic camphor is not synthetic within that definition, and I am bound to hold that it has been improperly included in the list as a synthetic organic chemical. It is, therefore, unnecessary for me to lay down any definition of a chemical. It has been urged that I ought to attach weight to the fact that the substance under dispute has for many

years been called synthetic camphor. But the truth is that that name was given to it to distinguish it from an already existing substance known as artificial camphor. The latter substance is not camphor at all, but apparently was commonly known as artificial camphor, and this led to the substance in dispute being inaptly termed synthetic camphor. I do not see how I can give any weight to this fact if I am able to arrive at a clear definition of the word "synthetic," and if that definition excludes the substance in question. There remains to consider whether I can hold that this substance is a fine chemical. Evidence has been given that it is not, and no evidence has been given that it is. Mr. Parry was very emphatic about it, and Dr. Forster was not asked to give any evidence on the point. Bearing in mind the evidence of the degree of purity of the imported substance, and the evidence I have had as to what is a fine chemical, I am satisfied that synthetic camphor is not a fine chemical. I certainly see no reason for not accepting Mr. Parry's evidence on this point. It is agreed that pinene is wrongly included in the list. The fact that it was included seems to indicate that there was some misunderstanding as to these substances. I therefore direct that pinene and synthetic camphor be removed from the list, and that the words "Komppa's synthetic camphor" be added.

GAS MANTLES.

The following is the final decision of the Referee concerning the complaint that incandescent gas mantles were improperly excluded from the list of articles chargeable with import duty (*cf.* J., 1922, 12 R., 179 R.):—

I have read the proceedings of December 3 last and I am quite satisfied that it is my duty to give effect to the view I had formed when I was asked to state a case—viz., that a mechanical aggregate of two dutiable substances was itself liable to duty. It is true that the Court expressed the view that certain of the questions asked did not arise, but the facts bearing upon that point were not before it.

The complaint was that gas mantles were improperly excluded from the list, and in the statement of their case the complainants asked only that gas mantles should be included, but quite early in the hearing it was clear that the question whether mechanical aggregates of dutiable substances were themselves dutiable was the first question to be determined. The complainants said they were, and on that contention based their demand for the inclusion of mantles. It was quite clear that a possible result was the inclusion of the mechanical aggregate as an ingredient of a gas mantle, even though the mantle itself could not be included. The question was in terms raised in paragraph 4 of the counter-statement of the Board of Trade. Evidence was called by the Board of Trade to the effect that the invariable practice of the Customs Authorities was to charge a duty on the value of the dutiable ingredient. Mr. Hunter Gray agreed that to the extent that there was thorium oxide and cerium oxide in the mantle these two bodies were covered by the words compounds of thorium and cerium. He took the point that that was not before me, but later both he and Mr. Whitehead said that, although the complaint was limited strictly to one issue, if I desired to go outside it, and it was within the terms of my appointment, they made no objection on the question of form. Finally, Mr. Whitehead expressly invited me as a question of construction to say that the schedule did not cover mixtures of the several compounds mentioned.

It seems to me quite impossible to say that the question whether mechanical aggregates of the oxides or of the nitrates of thorium and cerium was

not properly before me. I am inclined to think that it was expressly covered by the complaint that gas mantles were wrongly excluded from the list. If a gas mantle is liable to duty even in respect of an ingredient I think the total exclusion is wrong. If the point was not covered by the notice of objection the complainants had only to give another notice, the three months had not expired, and if the Board of Trade and Mr. Hunter Gray had persisted in their objection and not taken the course they in fact took, I am satisfied that the requisite notice would have been given. I, therefore, decide that the phrase compounds of thorium, cerium, etc., includes mechanical aggregates of oxides of thorium and cerium and of nitrates of thorium and cerium, and I award that the list be amended by including therein mechanical aggregates of oxide of thorium and oxide of cerium and of nitrate of thorium and nitrate of cerium being ingredients of incandescent gas mantles. I also award that the complainants pay the costs of the Board of Trade and of the National Gas Council of the Special Case, but not including any costs of any hearing before me.

SOCIETY OF CHEMICAL INDUSTRY.

FACILITIES FOR FILING ABSTRACTS.

Readers of the *Journal* who have frequently to consult the Abstracts Section are well aware that rapid reference to abstracts relating to a particular subject is not possible until the annual index has been published, unless some system of filing and indexing is adopted. The advantages of having the abstracts relating to a special subject, or group of subjects, collected together in readily accessible form and indexed up-to-date, need no emphasis. In order to facilitate such a system of filing, arrangements are being made, as stated in the Official Notice in this issue of the *Journal*, to provide members and subscribers with extra copies of the abstracts, printed on one side of the paper only, at a nominal charge, the amount of which will depend on the number of sets ordered. It is hoped that a large number will take advantage of this method of making their abstracts more easily accessible.

NEWS FROM THE SECTIONS.

MONTREAL.

At the March meeting two papers were presented. "Water Supply Purification," by Mr. J. O. Meadows, dealt with the constitution of various natural waters, the effect of the composition of the water shed, and the various methods for purifying the natural waters for commercial and municipal uses. The rapid sand type of filtration was described in detail, and slides illustrating various types of installations were shown. The zeolite process of water softening was also described and illustrated. Photographs of bacteriological cultures in raw and treated waters were shown and explained, and the method and value of sterilising waters by chlorination, etc. were discussed.

In the second paper, on "A Study of the Conditions causing Disintegration of Cement under Accelerated Test," Mr. A. G. Fleming gave a very full exposition of cement testing and conditions obtaining in the various processes of manufacture. The paper was well illustrated by slides, and comparative analyses of many samples of cements were given, in which it was shown that of three samples of practically identical analysis, one might be sound and the other unsound. This was shown to be true over a range of widely differing compositions.

OTTAWA.

A meeting of this Section was held in the University Club, Ottawa, on April 6, Mr. F. J. Hambly presiding.

The programme of the evening consisted of a symposium of papers on "Some Modern Problems in Agricultural and Food Chemistry." The first paper was read by Dr. Frank T. Shutt, who traced the development of the Experimental Farm in Canada from its inception in 1886. The speaker dealt with the reasons for the establishment of the experimental farms in Canada, which he said were primarily to encourage the development of agriculture and to assist the farmer in a profitable pursuit of agriculture. The farms were both educational and experimental in their work. Dr. Shutt also outlined the development of some of the work done by the Division of Chemistry, referring more particularly to the examination of soils and fertilisers and to the development of irrigation projects. Agricultural science, he said, was a phase of chemistry, and the assistance of a chemist was required in every division of the Experimental Farm. In this way the Division of Chemistry had grown into what was now in many ways a Bureau of Chemistry, serving not only every branch of the Department of Agriculture but also many other departments.

Dr. Shutt was followed by Col. Janson, of the Division of Chemistry, who spoke on the preservation of foods, with special reference to canning and dehydration. Col. Janson outlined the seven recognised ways of preserving foods, viz., drying, salting, pickling, smoking, refrigeration, canning and dehydration. He sketched the characteristics of each process, and traced in particular the development of the canning and dehydration processes.

SOUTH WALES.

A general meeting of the South Wales Section was held on May 26 at the University College, Cardiff. The notice convening the meeting having been read, it was announced that the Council of the Society had approved the formation of the South Wales Section, and letters expressing goodwill to the new Section and regret at inability to be present were notified from Mr. C. J. Waterfall (chairman of the Bristol and South Wales Section), and from Capt. H. Vivian, Mr. E. Walls, Mr. G. W. Clegg, and Mr. Willis Jones.

Dr. T. Howard Butler (past-chairman of the Bristol and S. Wales Section) proposed Prof. C. M. Thompson as chairman of the new Section, and he, together with the following other officers and committee, was elected:—Vice-chairman: Capt. Hugh Vivian; hon. treasurer: Dr. H. W. Webb; hon. secretary: Dr. H. E. Cox; assistant hon. sec.: Capt. J. R. Green. Committee: Drs. J. E. Coates, W. J. Jones, Messrs. H. J. Bailey, W. R. Bird, F. J. Bloomer, G. W. Clegg, W. J. Cooper, J. H. Duncan, E. Lawson Lomax, G. Madel, C. A. Seyler, and J. H. Wells. Messrs. R. R. Bird and Frank Bird were appointed auditors.

The Rules as circulated, but subject to certain small amendments, were proposed by Mr. W. J. Cooper and adopted. Dr. H. E. Cox proposed that the Section should admit Associates subject to conditions to be determined from time to time by the committee, and this was agreed to; the conditions prescribed were:—(a) The person shall be proposed and recommended by one full member of the Society, and elected by the committee. (b) No person shall remain an Associate for a period of more than three years unless the committee so determine in any special case. (c) Associates shall be required to pay an annual subscription of five shillings.

The chairman proposed a vote of thanks to Dr. Butler and the present and past chairmen of the Bristol and South Wales Section for their active interest and support in the formation of the new Section.

The Bristol and South Wales Section when formed in 1917 included the South Wales members. In 1918 and subsequently, meetings were held in Cardiff as well as in Bristol, and in 1920 and 1921 meetings have also been held in Swansea. The affairs in South Wales were arranged by a sub-committee of the Bristol and South Wales Committee which met in Cardiff, but as the interest in South Wales developed, it was felt by the committee and the sub-committee that the formation of a separate South Wales Section was desirable in the interests of members on both sides of the Bristol Channel.

LONDON.

On May 29, in the rooms of the Institution of Mechanical Engineers, Sir George Beilby read a paper entitled "The Structure of Coke: Its Origin and Development." Mr. E. V. Evans presided over a large attendance.

In charcoal and coke, carbon appears as the non-volatile residue of destructive distillation or carbonisation. It results from the decomposition by heat of the complex organic substances of which wood, peat, lignite and coal are composed, and the driving off by heat of the volatile products of this decomposition. The process is almost invariably accompanied by the fusion of some of the products of decomposition, and the simultaneous evolution of gases in the form of bubbles leads to frothing or foaming. It has been demonstrated that the ultimate structure of coke is of a sponge-like type resulting from the blowing of bubbles during the fusible stage through which the coal passes during carbonisation. For each type of organic material there is a stage in carbon concentration at which fusibility ceases and rigidity of the residue sets in. In some cases the range of fusibility is extended by raising the temperature of carbonisation. This is the case in coal and similar bituminous materials, whilst in carbohydrates like sugar and cellulose, the carbon concentration with resulting infusibility is definitely reached at a much lower temperature and no fresh access of fusibility can be induced by the application of higher temperatures.

In sugar we are fortunately provided with a pure chemical substance from which a carbonaceous residue can be prepared which is practically free from mineral and other impurities. After prolonged heating at 900° C. this residue only contains minute traces of hydrogen and oxygen, and it approaches more nearly to elementary purity than any form of carbon other than diamond or graphite. It is a homogeneous, glass-like solid, without metallic reflexion, with a perfectly smooth surface which does not scatter light even under concentrated illumination. In thin films it is perfectly transparent and is brown by transmitted light. The conclusion has been reached that in addition to the crystalline forms of carbon, diamond and graphite, there is a third form which is vitreous and probably of lower density than either of these. The recognition of the existence of carbon in the vitreous state raises interesting questions with regard to the packing of the carbon atoms in this state as compared with the packing in diamond and graphite; and Sir William Bragg has kindly undertaken to co-operate in further inquiries on the subject.

The study of the structure and properties of carbonaceous residues is much simplified by the knowledge that the carbon of which all forms of charcoal and coke are built up is a fairly homo-

geneous, vitreous solid in which the vitreous properties become more rather than less marked as the state of elemental purity is approached, and further, that the bubble structure which is developed during the fluid or plastic stage of carbonisation through the evolution of gases is finally stereotyped in this rigid vitreous material.

Experiments on the carbonisation of sugar have thrown a useful light on the subject, for in this case the passage from the fused to the rigid condition occurs at a comparatively low temperature. Rigidity sets in in the neighbourhood of 350° C., and at 400° C. frothing and bubble blowing have ceased.

Having ascertained the nature and origin of coke structure and the conditions which influence it, it can be so directed and controlled as to produce coke of any desired type. Under suitable conditions the bubble-blowing in the viscous coal substance can be so directed and regulated that the vitreous carbon is entirely broken up into thin films which expose an enormous oxidisable surface within the coke mass, whilst, if desired, the volume of the free-air space can be regulated by the scale of the bubble sponge structure which is produced. Coke of an apparent density of 1.33 has been produced, of which the internal reactive surface is equal to, or even exceeds, that of wood charcoal of little more than half that apparent density.

MEETINGS OF OTHER SOCIETIES.

SOCIETY OF GLASS TECHNOLOGY.

At the meeting held in University College, London, on May 17, Prof. W. E. S. Turner presiding, a paper entitled "Columnar Structure in Sandstone Blocks," by Mr. J. Currie, was read, in the absence of the author, by Mr. S. English. The author described the effect of leakage of metal from a glass-tank furnace on sandstone blocks forming the lowest course of the sides of the furnace. After the tank was dismantled, it was found that the blocks readily disintegrated into long prismatic columns, intersected by transverse joints. The evidence indicated that the formation started at the point of contact with the glass and that, as has been claimed for similar formations in Nature (e.g., at Fingal's Cave and Giant's Causeway), columnar jointing was distinctly related to the planes of cooling. Dr. J. W. French stated that he had obtained a similar formation by rapidly cooling a pot of optical glass. The sudden contraction caused the rupture to begin near the centre at the surface of the glass; the prismatic formation of the glass extended radially towards the bottom of the pot and continued in the clay forming the pot.

Mr. F. W. Adams, in a paper entitled "Some Practical Notes on the Manufacture of White Glass in a Tank Furnace," said that white flint-glass was gradually replacing pale-green glass for making food containers. Efforts were being made to reduce the higher cost of white flint-glass by using automatic machinery, but the costs could not be reduced until the demand became much greater. In view of the paucity of accurate, practical information, it was not surprising that many manufacturers of pale-green glass in this country had hesitated to embark on the production of white flint-glass by the use of decolorisers. The author has made observations on a tank of 110-tons capacity with a nominal output of 25 t. per day, and suggests the observance of the following points to enable consistently good results to be obtained:—(1) All batch materials, and

especially the selenium decoloriser, should be analysed completely. (2) The iron content must be very carefully regulated. (3) The batch ingredients must be carefully weighed and efficiently mixed. (4) "Filling on" must be regular. (5) Pyrometers should be used to maintain constant melting temperatures. (6) Lehr temperatures should be correct for a given type of glass and be kept constant by means of some form of temperature-recorder. It was advisable, said the author, to have at least two pyrometer stations in the Lehr, one at the front and one at the end of the heated space to maintain the proper temperature gradient. Articles differing greatly in weight should not be put together in the same Lehr. Selenium offered many advantages over other decolorising media, and would undoubtedly come into general use in this country for making white flint-glass, as in the United States, once the proper conditions governing its successful application were understood.

INSTITUTE OF PHYSICS.

The annual general meeting was held in the rooms of the Royal Society on May 23, Sir J. J. Thomson, who was elected president for the year beginning October 1, 1922, presiding. The annual report states that the membership of the Institute numbers 408, of whom 258 are Fellows. Although financial considerations at present bar the way, the Board contemplates the establishment of a central library for physics.

In his presidential address Sir J. J. Thomson discussed the projected "Journal of Scientific Instruments" (*cf.* J., 1922, 221 R). He said he had made a rough survey of the number of journals he bought or had sent to him, and found that it amounted to one a day. In spite of the multiplicity of publications there was none which was devoted to scientific instruments and scientific methods. We hardly realised the enormous part played by improvement in technique, not merely in improving our knowledge of physical and chemical constants, but in arriving at far-reaching generalisations about the constitution of matter and the action of one mass upon another. Modern conceptions of the nature of matter would not have been obtained without progress in the production of high vacua by means of the mercury pump and the utilisation of charcoal cooled with liquid air; and the progress of science would be immensely accelerated if the sensitivity of photographic plates could be increased fifty, or even twenty, times. The subject of scientific instruments and methods must be treated in a separate journal, because authors of scientific papers were more interested in describing their results than in giving detailed accounts of their apparatus and methods. That was rightly so; papers were already far too long, and the inclusion in them of such details would be intolerable. He hoped that all scientific workers and institutes would support the projected new Journal.

The Board was also considering the question of helping the members to obtain appointments. The depression in trade and the abundance of students of physics caused misgiving as to the future, but there was evidence that those students of physics or chemistry who were really first-class men did succeed in getting posts under present conditions. In 1921, of 67 students receiving grants from the Committee for Scientific and Industrial Research only 7 were not provided for on completing their scholarship course, and of these 7 two were women who got married. Of the 67 students, 10 entered Government service, 14 (of whom the majority were chemists) went to private firms or research institutions connected with industry, 10 obtained appointments in schools and 12 in universities, 8 received

advanced scholarships, and 6 obtained posts on their own initiative.

Sir J. J. Thomson then referred to the series of "Refresher Courses" which the Institute had inaugurated to enable physicists engaged in industry to keep in touch with the advance of their science, and in conclusion he expressed the opinion that the Safeguarding of Industries Act had greatly increased the difficulties of research in this country. He had lost more time since the war by the use of imperfect materials than he had lost in the previous 40 years he had been working. Research was a "key" industry, and was entitled to encouragement as such; the Government might at least help research workers by diminishing the delay in the receipt of apparatus, etc. purchased abroad.

SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting was held in the Chemical Society's Rooms on June 7, Mr. P. A. Ellis Richards presiding.

Dr. J. C. Thresh contributed a paper on "The Action of Natural Waters on Lead," in which he described the action of salts commonly present in water, and compared the results with those obtained with moorland waters. The action is not accounted for by the presence of small quantities of chlorides, sulphates, etc., but is due to an organic acid probably present in peat, and to a silicate, for by adding one or both of these the action of any natural moorland water can be imitated.

In a paper on "The Composition of Cow's Milk in the Sudan," Dr. A. F. Joseph and F. J. Martin recorded the analyses of cow's milk made during the last 10 or 15 years in the Wellcome Tropical Research Laboratories, Khartoum. As in other tropical countries cow's milk in the Sudan is rich both in fats and other solids. The total fat production is approximately the same in the morning and evening, and there is a distinct seasonal variation in composition.

The "Estimation of Meconic Acid in Opium" was described by Dr. H. E. Annett and M. N. Bose, the method used being as follows:—The meconic acid is precipitated as its calcium salt by adding excess of calcium-chloride solution to an aqueous extract of the opium. After washing, the calcium salt is decomposed with dilute hydrochloric acid, and the free meconic acid is crystallised, washed, dried, and weighed. Corrections are applied for unprecipitated meconic acid and for meconic acid dissolved by the hydrochloric acid under the experimental conditions.

In conclusion, Mr. W. Singleton discussed the use of the "daylight" lamp in volumetric and colorimetric analysis. The lamps used, which are inexpensive, are of the tungsten-filament type fitted with "daylight" glass bulbs. The results of numerous titrations in natural daylight, artificial daylight, and ordinary artificial light, showed that, with many indicators, the range of colour covered by the end-point is shorter and can be observed more accurately in artificial than in natural daylight.

THE CHEMICAL SOCIETY.

An ordinary scientific meeting was held on June 1, Prof. T. M. Lowry presiding. The following three papers were read:—(1) "The reactivity of doubly-conjugated unsaturated ketones. Part III. Unsymmetrical hydroxy- and methoxy- derivatives." (2) "Phenopyryllium salts of distyryl ketones. Part I.": J. S. Buck and I. M. Heilbron. (3) "Ring-chain tautomerism. Part II. The effect of the gem-diethyl group on the carbon tetrahedral angle": S. S. Deshapande and J. F. Thorpe.

CORRESPONDENCE.

RAND METALLURGICAL PRACTICE.

SIR,—In your issue of March 31 I note the account of a paper read before the London Section of the Society by Mr. W. Cullen on "Gold Metallurgy of the Witwatersrand, Transvaal." In this he makes the statement that: "At present one-half of the Rand mines is making no profit, and some are working at a loss owing to the increased cost of labour and materials; but by the adoption of a new process, which will produce one product, slime, the whole cycle of operations will be simplified, for both stamp-crushing and amalgamation will be eliminated. This will materially reduce operating costs and the capital outlay for new plants."

Under the conditions outlined it would seem illogical to feature an anticipated saving in cost by the erection of alternative equipment. The existing plants on the Rand are more than sufficient for the ore reserves at present known to exist. In regard to the alleged simplification of treatment by the adoption of all-sliming, I fail to see any justification for such a contention. The original "simple" plan of all-sliming in one well-known plant has been augmented from time to time, and the scheme of operations now includes stamp-milling, ball-milling, tube-milling, concentration on shaking-tables, re-grinding of the concentrate, special vacuum-filter treatment of a separated slime, mechanical agitation, counter-current decantation of solutions from the bulk of the slimed ore, and mechanical filtration of the tailing from the counter-current decantation plant. The record of the company has shown a steady absorption of capital expenditure for alternative equipment since the original plant was erected; and high depreciation allowances have been a feature of the accounts.

Mr. Cullen is not reported as having commented in any way on the oft-claimed advantages, from the metallurgic standpoint, of abolishing amalgamation and leaching and adopting all-sliming. Personally, I feel that little scope for improvement exists in this respect. If the amount of gold in the average Rand residue can be reduced, this will be done by some minor elaboration of existing methods rather than by a disregard of proved practice. The excellent results being obtained in South Africa are too often ignored by reformers, who harp on the advisability of adopting what are termed up-to-date treatment methods, forgetful of the fact that all-sliming is only up-to-date in that it was adopted in comparatively recent times for the reduction of silver ores. It was used in the early days of cyanidation at Kalgoorlie to facilitate the extraction of gold in a rebellious sulpho-telluride ore. In both these cases all-sliming was and is essential; but I maintain that it is economically inapplicable in the case of the great majority to simple gold ores, especially those of the Witwatersrand. It is expensive, in regard to first cost of plant, operating cost, and depreciation cost. Its adoption usually results in an avoidable loss of gold in residue.

I recently had occasion to analyse from the metallurgical standpoint the annual report of a typical Rand mining company. The ore averaged 5·807 dwt. per ton. This was crushed and ground in stamp- and tube-mills. After amalgamation it assayed 1·597 dwt. per ton. The mill-tailing was divided into two products, sand and slime. The sand, 60 per cent. of the whole, was leached; before treatment it assayed 2·099 dwt., and 0·333 dwt. afterward. The slime assayed 1·118 dwt. before treatment and 0·183 dwt. afterward. Re-calculated into percentages I found that the ore entering the plant assayed less than one-thousandth of 1 per cent. gold.

After treatment it contained less than one-half of one ten-thousandth of 1 per cent., or 0·000046 per cent. to be exact.

The results of operations such as these indicate the importance of amalgamation and gravity leaching from the economic as well as from the metallurgic standpoint; and these are the fundamental features of Rand metallurgical treatment. I do not understand how serious attention can be paid to the claims of the proponents of the all-sliming idea until some concrete evidence is forthcoming in support of the contention that the abandonment of amalgamation and gravity leaching will result in lower operating or depreciation costs or in a higher recovery of gold.—I am, Sir, etc.,

A. W. ALLEN.

Berkeley, California.

April 18, 1922.

Could Mr. Allen have seen my paper as it was read he would have found that there is little difference between us. My object, however, was to record the changes which had taken place in metallurgical practice on the Witwatersrand during the past 20 years and to indicate tendencies for the future. I must, of course, concede that the stamping capacity is more than sufficient for visible ore reserves, but the protagonists of the new metallurgy claim that stamps are both uneconomic and costly. I personally agree that this is so, but I also think that it would never pay to scrap existing installations. In other words, the so-called new metallurgy can only be applied to extensions of old plants or to entirely new ones. At the most the doing away with stamping, amalgamation and the orthodox cyanide treatment of sands and slimes and the substitution therefor of the suggested all-sliming process can only mean a saving of 1s. per ton in operating charges, *plus* a substantial reduction in capital outlay. I feel pretty certain that the operating charges can be reduced by this amount, but I am not so certain about the capital savings.

With regard to the proposal to do away with amalgamation, I must confess that taking this single stage by itself, there is much to be said for its retention in any scheme, as it is cheap and effective and accounts for the gold at an early stage. There is, however, much to be said on the other side, as Mr. Allen no doubt knows.

W. CULLEN.

Surbiton, Surrey.

May 30, 1922.

THE HULL MEETING OF THE BRITISH ASSOCIATION.—The inaugural general meeting will be held in the City Hall, Hull, on Wednesday, September 6, when Sir C. S. Sherrington will assume the presidency in succession to Sir Edward Thorpe and will deliver an address on "Some Aspects of Animal Mechanism." On September 8 Dr. F. W. Aston will give the First Evening Discourse on "The Atoms of Matter; their Size, Number and Construction." The Sectional Meetings start on the morning of Thursday, September 7, when Principal J. C. Irvine, president of Section B (Chemistry), will deliver an address on "Research Problems in the Sugar Group." The programme of this Section is not yet available, but one of the chief items will be a joint discussion with Section K (Botany) on Photosynthesis. Chemists will also be interested in a joint discussion on Vitamins arranged by Section I (Physiology) and Section M (Agriculture). The Civic Reception will be held on September 7, and there will be the usual Citizens' Lectures, excursions, and other entertainments.

NEWS AND NOTES.

SOUTH AFRICA.

The New Corundum Industry in the North-eastern Transvaal.—The Transvaal corundum fields cover an area of over 2000 sq. miles in the Zoutpansberg and Pietersburg districts. Both crystal and boulder (containing felspar) corundum are found and the richest areas lie between Zoekmakar and Louis Trichardt, especially around Bandolier Kop and in the low country east of the Selati railway. Active development of these deposits was started during the war owing to the urgent demand for abrasives, and by 1918 the export had reached 3875 tons. At that time primitive methods of recovery were employed and preparation for the market was limited to washing in rotary pans, but after the war, in face of large stocks of corundum and renewed competition from artificial abrasives, the adoption of improved methods of recovery and grading became necessary.

By using mechanical methods of crushing, concentration and grading similar to those used in tin mines, the Zoutpansberg Corundum Co. has found it possible to produce superior grain corundum economically by means much simpler than those used at the Craigmont Mill in Canada, before it was burnt down. The output per 9-hr. day varies from 2.5 to 3 tons of grain corundum, which is produced in 15 grades, and sells at £20–£23 per ton, f.o.r. Bandolier Kop. Analyses show the product to contain Al_2O_3 94.9–96.5%, SiO_2 1.2–2.3%, TiO_2 0.15%, and H_2O 1.25–2.2%. Large reserves of corundum-bearing rock are available, and as the product is free from deleterious mineral matter and can be sold at a price comparing favourably with that of artificial abrasives, such as carborundum and alundum, the future of the industry is regarded hopefully.—(*S. Afr. J. Ind., Apr., 1922.*)

FRANCE.

Industrial Notes.—Chemical Industry.—The chemical market has been dull, but especially noteworthy has been the greatly reduced importation of German chemicals. Demand has been very poor during the past two months, and the wide fluctuations in the value of the mark have made selling prices very uncertain. Certain chemicals have lately reached a price-level which renders them unattractive to buyers, but more recently a decline has occurred, although not in the prices of alkalis and paint materials.

Prof. Lindet read recently a paper before the Academy of Sciences describing a method discovered by a Belgian chemist, M. Camille Deguide, for recovering the sugar from beet molasses. In 1838 the French chemist Peligot discovered the use of baryta for this purpose, but his method could not be applied industrially as the baryta was too expensive. M. Deguide does not decompose the barium carbonate, produced on carbonation, by heat alone, but heats it in a furnace with silica and then decomposes the barium silicate with water and recovers the baryta. This modification of Peligot's process is expected to be an economic success.

Petroleum.—Borings at Grouelle, near Clermont-Ferrand, have disclosed the existence of petroleum, but the amount available has yet to be determined.

Potash.—The Chamber of Commerce at Lyon proposes to make that city the distributing centre for all potash mined in Alsace. Lyon has been chosen instead of Mulhouse because of its better transport facilities; it is connected by road and canal with Havre and Marseilles and with Alsace by the Rhine-Rhone canal.

Metallurgy.—Exports of iron ore from France have decreased considerably because Germany is

trying to obtain other sources of supply; this policy is hardly likely to be persisted in owing to the proximity of the French mines, the quality of the ore, and the lower cost of transport compared with that from more distant mines. According to statistics published by the "Comité des Forges de France," out of 222 blast-furnaces existing in France on April 1 last, 85 were in operation, including 33 in Eastern France and 30 in Alsace-Lorraine. The total output of pig iron and steel during the first quarter of 1922 was 1,013,405 metric tons and 998,254 t., respectively.

Colonies.—The French President's recent visit to the colonies in North Africa has been followed by the publication of some interesting information concerning their industrial and economic development. Morocco now possesses over 2600 miles of roads and 875 miles of narrow-gauge railway; in one year's time a network of broad-gauge railways will be opened up for traffic, and in three years it will be completed. Work will soon be started on the rich phosphate deposits. Irrigation is being applied extensively and water-power harnessed to produce electricity. The cultivation of cereals, fruit trees, and beets has made great progress. A special feature in Algeria is the growth of wine-production, the total area under vines now being about 420,000 acres. The "Tell" district produces large quantities of fruits and vegetable oil, and the value of the wool crop, which 10 years ago was 5 million francs, is now 47 millions. In Tunis the vineyards occupy 75,000 of the 494 million acres under cultivation.

Exports of Minerals from Algeria in 1921.—The dull market and reduced prices of metals in 1921 seriously affected the sales of all Algerian minerals except phosphate. Exports in 1920 and 1921 were as follows:—

	1920.	1921.	
	Total.	Metric tons.	To France.
Phosphates, natural	334,704	372,010	06,370
Iron ore ..	1,114,418	684,964	22,491
Copper ore ..	601	2,007	2,007
Lead ore ..	12,804	11,421	8,213
Zinc ore ..	27,716	17,537	4,208
Antimony ore ..	2,066	320	10
Manganese ore ..	5,250	1,803	1,800
Mercury, native	200	—	—

—(*U.S. Com. Rep., Apr. 3, 1922.*)

UNITED STATES.

Phosphorus in Californian Petroleum.—Mr. Chase Palmer (*Econ. Geol.* XVII., No. 2, 1922) has been led (through the examination of the underground waters of the Californian oil-fields, in which phosphates are found) to examine carefully the oil for phosphorus. Quantities amounting to one one-hundredth per cent. have been found. Taken in conjunction with the occurrence of nitrogen, the author considers it another link in the chain of evidence that Californian petroleum is of animal origin.

Fuel Briquettes in 1920.—On account of the shortage and high price of raw coal, the fuel-briquetting industry made rapid strides in the United States during 1920 and produced the record output of 567,192 net tons, an increase of 92 per cent. over 1919. The number of plants increased from 12 to 15 and the value of the output from \$2,301,054 to \$4,623,831, the greatest increase being in the Eastern States. The total quantity of raw fuel used was 572,039 t., of which 62 per cent. was anthracite and semi-anthracite, 22 per cent. semi-bituminous and bituminous slack, and 16 per cent. lignite, sub-bituminous coal and oil-gas residue; the difference of 4847 t. between the amount of raw fuel used and the weight of briquettes made was due to screening off large sizes and to removal of water during briquetting. Asphaltic pitch and coal-tar pitch remained the standard binders and were used

either singly or in admixture in 76 per cent. of the total output; about 60 per cent. of the output of briquettes was made either with asphaltic pitch alone or with a compound binder of which asphaltic pitch was the chief constituent.—(*U.S. Geol. Surv., Sept. 19, 1921.*)

Cement in 1919 and 1920.—On account of the revival in the building industry the sales of hydraulic cement in the United States improved by 20.7 per cent. to 86,141,488 barrels in 1919 and by 12.7 per cent. to 97,079,200 barrels in 1920. In 1920 the output was made up of 767,481 barrels of natural and puzzolan cement and 100,023,245 brls. of Portland cement, representing increases of 45 and 24 per cent., respectively, over the previous year; the production of Portland cement thus increased from 60 to 68 per cent. of the total capacity. The number of rotary kilns in use rose from 720 to 753, and the number of plants at which potash was recovered declined from 14 to 8, the production amounting to 1258 short tons of K_2O in 1919 and 1147 t. of K_2O in 1920. Exports of cement in 1920 were 2,985,807 brls., an increase of 21 per cent.; the exports go mainly to South and Central America. Imports increased from 8931 brls. in 1919 to 524,604 brls. in 1920, of which 516,332 brls. was derived from Canada and 1984 brls. from England.—(*U.S. Geol. Surv., Sept. 21, 1921, Mar. 7, 1922.*)

CANADA.

The Pulp and Paper Industry.—The St. Croix Pulp and Paper Co., at Hartville, Nova Scotia, has been reorganised and will in future be known as the Premier Power and Pulp Co. The capital has been increased to \$2,000,000 and improvements will be made in the old plant to increase its annual output to 8000 tons of newsprint and 5000 tons of wrapping paper. The surplus pulp will be sold in the United States and Great Britain.

The Provincial Paper Mills Co., Ltd., has just announced that it will expend \$1,500,000 on the extension of its plant at Port Arthur, Ontario. This company manufactures book, bond and coated papers in its mills at Georgetown, Mille Roches and Thorold, Ont., and has also a sulphite-pulp mill at Port Arthur. It has obtained from the Ontario Government pulp-wood rights over 1300 sq. miles of forest in the Port Arthur district.

According to American opinion, the proposed import duty of 5 per cent. on chemical pulp would have very little effect upon the pulp trade of the United States, as it would not suffice to shut out importations from Canadian and Scandinavian sources. The Americans are, however, worried over the possible attitude of the Canadian Government on the question of the exportation of pulp-wood. Many Americans think that the Canadian Government might prohibit exportation or impose an export tax upon the pulp-wood entering the States and thereby cut off the supply of raw material of a large number of American mills. The feeling in the States is that Canada would be justified in taking such action. The Canadian provincial governments can prohibit the exportation of pulp-wood from government lands, but not of pulp-wood cut upon private property, which could only be effected by Dominion legislation at Ottawa. Premier Taschereau, of Quebec, has practically called for such legislation in view of the United States' tariff proposals.

The Starch and Glucose Industry in 1920.—According to the Dominion Bureau of Statistics, this industry produced goods to the value of \$8,379,185 during 1920; this compares with \$7,953,273 in 1919. The capital invested was \$6,112,124; salaries and wages amounted to \$1,062,104 for 768 male and 116 female employees. The amount of power used was

3126 h.-p. and the cost of fuel was \$446,617. Raw materials at works cost \$5,936,610. There are three plants in Ontario which practically constitute the whole industry. Those in Quebec and Prince Edward Island, producing starch, employ only ten persons. The exports fell from \$110,982 in 1919 to \$12,234 in 1920. Imports of raw materials and finished products were valued at \$853,504 in 1920.

The Explosives Industry.—The Lindsay Arsenal, Lindsay, Ont., the largest ammunition factory of the Dominion Government, was closed down permanently on March 31 last. The Atlas Powder Co. of America is operating the new plant of the Northern Explosives, Ltd., at Dragon, Que. This company is the owner of the Giant Powder Co. of Canada, which has a large plant at Nanoose Bay, B.C.

Production of Explosives in Canadian Factories during the year 1921.

Class	I.	Gunpowder	..	..	..	..	lb. × 1,000.
..	II.	Nitrate mixture	..	..	..	..	97
..	III.	Nitro compounds—	..	..	..	..	963
		Division 1	..	..	..	..	10,491
		Division 2	..	..	..	..	108
..	IV.	Chlorate mixture—	..	..	..	..	130
		Division 2	..	..	..	..	130
		Powder and blasting explosives in bulk	..	..	..	..	20,789
Class	V.	Fulminate—	..	..	..	..	59
		Division 1	..	..	..	..	59
..	VI.	Ammunition—	..	..	..	..	74,000
		Division 1—	..	..	..	..	Output of 1 factory
		Safety cartridges	..	..	..	..	960
		Safety fuse	..	..	..	..	3,664
		Railway torpedoes	..	..	..	..	9,982
		Percussion caps	..	..	..	..	9,982
		Division 2—	..	..	..	..	9,982
		Detonators and electric detonators	..	..	..	..	9,982
..	VII.	Fireworks—	..	..	..	..	\$168,000
		Division 2 (approx.)	..	..	..	..	\$168,000

¹ Exclusive of artillery ammunition.

Explosives imported into Canada, January 1 to December 31, 1921.

Class	I.	Gunpowder	..	..	..	..	lb.
..	III.	Div. (1) Mixtures of liquid nitro compounds	..	..	..	..	18
..	II.	" (2) Nitro compounds—	..	..	..	..	5,088
		(a) Propellants	..	..	..	..	61,233
		(b) For use in explosives factories	..	..	..	..	1,263,751
		(c) For other manufacturing purposes	..	..	..	..	2,350
..	V.	" (1) Fulminates	..	..	..	..	6,000
..	VI.	" (1) Percussion caps	..	..	..	..	807,100
..	II.	" (2) Miners' squibs	..	..	..	..	200,000
		" (3) Detonators and electric detonators	..	..	..	..	893,100
..	VII.	" (2) Manufactured fireworks	..	..	..	..	258,000 (approx.)

GENERAL.

The D'Arcy Oil Well in Scotland.—Mr. J. E. Hackford writes as follows concerning the second discovery of oil in Great Britain, which was made at D'Arcy in Scotland on May 6, 1922. The first analysis of the oil gave:—Specific gravity (60° F.), 0.819; gasoline, 15%; kerosene, 25%; gas oil, 35%; lubricating oil, 25%. The oil has a paraffin base, containing traces of naphthenes.

The analysis is particularly interesting because it is the second published instance of the efficacy of the new method of determining the nature of underground oil by the application of pure chemistry to the study of the seepages which occur on the earth's surface. By this method it is possible not only to indicate the best spot for drilling, but to predict the exact nature of the underground oil. The prediction of the nature of the subterranean oil at D'Arcy was made on November 6, 1917, and was the result of an investigation which was undertaken to decide, if possible, whether the oil present in shale originated in the shale itself, or if it entered the present beds from the outside. This new method of chemical

investigation of seepages has been tried and found to be successful in other countries, but the only two published instances are those of Hardstoft and D'Arcy. There is no doubt that, when permission has been obtained to publish the accounts of the investigations and reports that apply to countries other than Great Britain, they will prove to be of great interest.

Graphite in 1920 and 1921.—According to the United States Geological Survey the sales of domestic graphite in that country increased in 1920 by 28 per cent. to 9510 short tons, but declined in value by 20 per cent. to \$626,202. The number of producers fell from 20 to 17, of which 7 were in Alabama. Of amorphous graphite the output was 4694 t. and of crystalline graphite 4816 t., and the Acheson Graphite Co. produced about 3700 t. of manufactured graphite. Exports in 1920 comprised roughly 607 t. of unmanufactured graphite (\$112,771), manufactures worth \$610,261, and pencils and pencil leads worth \$3,849,221; the value of the export of raw graphite increased by 25 per cent., but that of the export of manufactures decreased by 23 per cent. Imports totalled 21,095 t., including 16,114 t. of crystalline graphite, and were derived from Ceylon, Madagascar, Mexico and Canada, in the order named.

From a German source we learn that the world's production of graphite in 1921 was lower than in any year since 1902, but the decline in 1920 and 1921 was a natural result of over-production during the war. Details of the world's production in 1921, 1920 and 1913 are appended:—

	1921.	1920.	1913.
		Metric tons	
Germany ..	30,000	20,487	12,057
United States ..	2,346	8,627	4,332
Canada ..	367	2,020	1,901
Mexico ..	3,088	3,319	4,023
Austria & Steiermark ..	10,800	11,543	17,282
Bohemia & Mähren ..	8,500	15,000	32,175
Italy ..	3,000	4,190	11,145
Ceylon ..	4,422	9,352	28,096
Japan ..	550	1,135	667
Korea ..	11,000	14,000	14,543
Madagascar ..	—	4,000	7,907
Other countries ..	—	—	1,320
Total ..	85,000	100,000	136,493

Production of Mercury in Russia in 1921.—After a stoppage lasting two years work was resumed in the quicksilver mines at Nititorka in the middle of July, 1921. Production of mercury during the period July, 1921, to January, 1922, was as follows:—July 210·3 lb.; August 467·7 lb.; September 345·4 lb.; October 3780 lb.; November 2808 lb.; December 2700 lb.; January 1363 lb. The three pits, of which only one is being operated, are provided with electrical equipment; under normal conditions they can deliver about 72,000 lb. of ore containing roughly 0·5 per cent. of mercury per day.

Soda Lake in Siberia.—Large quantities of sodium carbonate are present in the Siberian lake Petuchow, which is situated in a very fertile region close to the line of the unfinished South Siberian railway. Plans are under consideration for the erection of a soap factory to utilise a large part of the production of soda ash, which, it is hoped, will amount to 50,000 metric tons yearly.

Manufacture of Soda in French Indo-China.—A large factory for the manufacture of soda and related products is being erected near Haiphong by the Société Industrielle de Chimie d'Extrême-Orient at a cost of 11½ million francs. The company expects to supply caustic soda and other chemicals to paper, glass, soap, and textile factories in the East. Labour is plentiful and cheap, and the factory, which is practically completed, is favourably situated for the supply of raw materials. The

undertaking is in the hands of experts sent from France to exploit the methods discovered by G. Claude and successfully used by the Société L'Air Liquide of Paris.—(*U.S. Com. Rep.*, Apr. 10, 1922.)

The World's Petroleum Output in 1921.—The American Petroleum Institute estimates the world's output of petroleum in 1921 as follows:—

	1921.	1920.
	Thousand Barrels.	
United States ..	469,639	443,402
Mexico ..	195,064	163,540
Russia ..	28,500	25,430
Dutch E. Indies ..	18,000	17,529
Persia ..	14,600	12,353
Rumania ..	8,340	7,435
India ..	6,864	7,500
Poland (Galicia) ..	3,665	5,806
Peru ..	3,568	2,817
Japan and Formosa ..	2,600	2,140
Trinidad ..	2,354	2,083
Argentina ..	1,747	1,666
Egypt ..	1,181	1,042
Venezuela ..	1,078	457
France ..	392	389
Germany ..	200	212
Canada ..	190	197
Italy ..	35	34
Algeria ..	3	4
England ..	3	3
Other countries ..	1,000	1,016
Total ..	759,030	604,853

—(*Min. Mag.*, Apr., 1922.)

British Guiana in 1920.—The decline in the sugar crop from 106,000 tons (average of the previous 9 years) to 87,180 t., was due to scarcity of labour and of sulphate of ammonia, as well as to unfavourable seasons; over 85 per cent. of the 69,530 acres under cane was planted with new varieties. The area under cacao remained unchanged, but that under Para rubber fell to 2806 acres owing to leaf disease and shortage of labour. Investigations on the yield and cost of collecting rubber at the Government experimental stations continued to give satisfactory results. Balata bleeding was continued and 480 t. of balata was exported. The 21,753,000 coconuts, grown on 24,400 acres, were mainly utilised locally in manufacturing oil; 15 t. of copra, 20,093 gallons of coconut oil, and 2,621,000 nuts were exported. Limes were grown on a smaller area, but the Government factory at Onderneeming, Essequibo, was worked successfully. The export of lime products included 571 cwt. of citrate of lime, and 2400 galls. of raw and 3600 galls. of concentrated lime juice.

A total of 12,962 oz. of gold (a decline of 3524 oz.) was produced by placer washing and dredging, and 234,456 diamonds weighing 39,362 carats, valued at £211,829, were won. Three licences were issued for petroleum exploration in the North-Western and Pomeroon districts, but no definite results were recorded and the results of surface examinations by geologists are believed to be unfavourable to the occurrence of mineral oil. The Demerara Bauxite Co., which exploits the bauxite mines at Akyma, on the Demerara River, shipped 31,379 t. of dehydrated ore during the year. The completion of the light railway from Akyma to Mackenzie and the erection of crushing, washing, and drying plants at Mackenzie contributed to more economical handling of the ore.

Sugar, rum, molasses, molascuit, and citrate of lime are among the chief exports, and leather, cacao and matches are prepared for local consumption. The exports in 1920 increased in value by £1,902,166 to £6,142,998, and the imports by £1,588,674 to £5,179,486. Of the total trade, the United Kingdom took 35·30, Canada 28·44, and the United States 21·47 per cent., as compared with 57·40, 20·52 and 10·91 per cent., respectively, in 1914. Trade with the United Kingdom has improved since the war and should expand still further in the near future.—(*Col. Rep.-Ann.*, No. 1109, 1922.)

The Flax Industry in St. Helena.—The Government flax mill worked for 186 days during 1920, producing 95 tons of fibre and 55 tons of tow (40½ t. and 27 t., respectively, in 1919). The average prices obtained on the London market were £54 15s. per ton for fibre and £36 15s. for tow. As may be seen from the comparative weights of fibre and tow, flax was still being cut much too young, and in spite of the satisfactory prices obtained the supply was so short that the mill was only able to be employed two or three days a week. This was most unsatisfactory, as it is impossible to make a profit, even with a good market, if labour costs are continuous and production intermittent. Freights also were extremely heavy, and will become prohibitive in the near future should the price of fibre fall. The two private mills on the island produced, respectively, 155 t. of fibre, 90 t. of tow, and 140 t. of fibre and 110 t. of tow, so that the total production for the year 1920 was 287 t. of fibre and 195 t. of tow. The exports of these materials were valued at £33,759 (£27,108 in 1919), exclusive of 117 coils of St. Helena rope.—(*Col. Rep.-Ann.*, No. 1084, 1921.)

PERSONALIA.

A bequest from Mrs. E. B. Eddy will enable a chair of industrial chemistry to be established in McGill University, Montreal.

The late Sir W. P. Beale bequeathed, on the death of his wife, sums of £5000 and £200 to the Royal Institution of Great Britain and the Mineralogical Society respectively.

On June 10 Sir Alfred Mond, Minister of Health, unveiled at Winnington, Northwich, a bronze statue to the late Sir John Brunner, one of the founders of Brunner, Mond and Co., Ltd.

In addition to having placed the sum of £350,000 at the disposal of the trustees of the Nottingham University College, Sir Jesse Boot has given £20,000 towards the endowment of a chair of chemistry. The foundation stone of the new University buildings will be laid by Lord Haldane on June 14.

Dr. E. W. Washburn, professor of ceramic chemistry and engineering in the University of Illinois, will, on July 1, succeed Dr. F. G. Cottrell as chairman of the Division of Chemistry and Chemical Technology of the National Research Council of the United States. The chief work of the Division in the coming year will be the compilation of the Critical Tables of Physical and Chemical Constants.

On the occasion of his fifty-seventh birthday H.M. the King has conferred the honour of knighthood upon: Prof. W. M. Bayliss, professor of general physiology in University College, London; Prof. F. W. Keeble, Sherardian professor of botany in the University of Oxford; and on Dr. E. J. Russell, director of the Rothamsted Experiment Station. Major A. W. J. Lynsdale, acting professor of materia medica in the Medical College, Madras, has been made a Companion of the Imperial Service Order; and Mr. E. H. Hankin, of Allahabad University, late chemical examiner to the Government of the United Provinces, has been awarded the Kaiser-i-Hind Medal of the First Class for Public Services in India.

We regret to record the death on June 10 of Prof. W. Gowland, professor emeritus of metallurgy in the Royal School of Mines and an original member of this Society, in his 80th year.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Imports of Chemicals.

Answering Mr. Hogge, Mr. Baldwin gave the following figures of imports of certain chemicals into the United Kingdom during the six months ended March 31, 1922:—

			Declared Value.
Cream of tartar	Tons. ..	137.7 ..	£ 14,760
Tartaric acid	" ..	65.5 ..	7,608
Citric acid	" ..	6.1 ..	1,618
Acetic acid, acetic anhydride ..	" ..	1,541 ..	42,353
Vinegar and acetic acid for table use	Gallons. ..	86,203 ..	14,904
Tartar emetic	Tons. ..	6.0 ..	844
Potassium ferrocyanide	" ..	1.0 ..	199
" R " Naphthalene	" ..	20.2 ..	332
" K " Ammonium phosphate ..	" ..	83 ..	4,662
Potassium permanganate	" ..	20.9 ..	1,086
Sodium acetate	" ..	509.4 ..	1,340

There were no imports of "R" anthracene or sodium permanganate during the above period.—(May 18.)

Experimental Station for Mining.

In the discussion in Committee of Supply on the vote for the Mines Department, Mr. Bridgeman said that one-fifth of the Welfare Fund (set up under the Mining Industry Act by the levy of 1d. per ton on coal produced), which now amounted to about £1,000,000, could be expended on national purposes, and it had been decided to erect a new experimental station to replace that at Eskmeals, which was inconveniently situated and a good deal of the plant in which was worn out.—(May 18.)

British Cellulose Company.

Sir R. Horne informed Mr. Wise that the Cellulose Holding and Investment Co. had an option to purchase the power station of the British Cellulose Co. for £200,000, and was purchasing £500,000 first mortgage debenture stock from the latter company. The Government had no nominee on the board of, or financial interest in, the former company.—(May 25.)

Dyestuffs.

In answer to Mr. T. Thompson, Mr. Baldwin said that he had read the speech of the chairman of the British Cotton and Wool Dyers' Association complaining of the difficulty of obtaining satisfactory colours and asking for the appointment of a committee to investigate the administration of the Dyestuffs Act. There was no need or any strong desire for the appointment of such a committee.

Replying to Major M. Wood, Mr. Baldwin stated that 686 tons of "reparation" dyes, valued at 33,300,000 paper marks had been handed over during the financial year 1921-22 by the Board of Trade to the Central Importing Agency, which had received a commission of £18,020 (1 per cent.) on sales amounting to £293,323.—(May 29.)

British Dyestuffs Corporation.

Mr. Baldwin informed Mr. Ormsby-Gore that he was unaware of the reasons for the resignation of Dr. Levinstein from the directorate of the Corporation, but that matter and any criticisms of the directorate were questions for the shareholders, and he was not prepared to appoint a committee of inquiry. The activities of the Corporation could be discussed on the appropriate Estimates.—(May 29.)

In reply to Rear-Admiral Adair, Mr. Baldwin said that the Government directors of the Corporation, Lord Ashfield and Sir H. Birchenough, fully agreed with the policy of the Board. Highly technical qualifications were not necessary for administering large companies, but both directors had

much experience of directing large commercial and industrial undertakings. The resignation of Dr. Levinstein was being investigated.—(May 31.)

Imports of Sugar.

In a written answer to Capt. W. Benn, Mr. Young said that during 1921 the full rate of duty, amounting to £25,214,640, had been paid on the net amount of 1,013,685·3 tons of imported sugar retained for home consumption, and the preferential rate, amounting to £7,490,649, had been paid on 363,408·7 t.—(May 29.)

Road Tar.

Replying to Major Hills, Sir A. Boscawen said that the report of the committee appointed to investigate the poisonous effects of road tar on fish life had been circulated to all Highway Authorities, but there was no power to compel them to adopt any particular form of road-surfacing.—(May 29.)

Unemployment in Germany.

Sir M. Barlow, in answer to Mr. Lyle, said the latest returns of unemployment in Germany showed that out of a total trade-union membership of 6,281,233, 71,001, or 1·1 per cent., was unemployed. The corresponding percentage at the end of February was 2·7, and March 3·6.—(May 30.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Synthetic Camphor.—The Referee's decision in the synthetic-camphor case does not cover other synthetic substances, e.g., certain perfumes.—(May 22.)

Scheduled Articles.—In drawing up the list of scheduled articles, it was thought undesirable to consult any parties that might be directly affected by the inclusion or exclusion of any commodity. No commodities included in lists A to G of the Schedule have been deleted in consequence of the Referee's decisions, but 31 commodities have been removed from the list, and the grade of duty on 17 other articles has been changed.—(May 22, 29.)

Duty collected under Part I. of the Act during April amounted to £21,873, derived as follows: goods consigned from France, £3625; Belgium, £341; Germany, £10,138; Holland, £1409; Japan, £76; and the United States, £3668.—(May 22.)

"Bayer 205."—The Board of Trade does not know the precise chemical composition of this drug (cf. J., 1922, 218 R), but unless it is identical with or contains any scheduled commodity it is not dutiable under the Act.—(May 24.)

Vacuum Flasks for laboratory use are dutiable as they are classified as "scientific glassware," a heading which does not include the ordinary vacuum-flask food containers.—(May 29.)

Fees.—The total fees payable to the Referee under Section 1 (5) of the Act up to March 31 will not exceed 700 guineas.—(May 2.)

Glass Containers.—The complaint made under Part II. regarding glass containers is limited to containers with openings of less than 5 in. internal diameter and to empty bottles. If a complaint respecting filled bottles is made, the Board will consider whether there is any *prima facie* case for reference to the Committee.—(May 29.)

Enforcement of the Act.—Owing to pressure of other business the Government has been unable to discuss this question.—(May 29.)

Reports.—Papers relating to complaints under Part II. which are not referred to committees are not laid before the House, but as the proceedings of the Committees of Inquiry are public their reports will be published.—(May 29.)

COMPANY NEWS.

BRITISH COTTON AND WOOL DYERS' ASSOCIATION.

In his address to the shareholders on May 24, in Manchester, Mr. A. Hoegger said that dye-consumers had been dissatisfied at not obtaining many of the colours they required, and the delay in providing them was detrimental to the dyeing industry. In many cases substitutes offered for colours for which licences were refused were quite different from the actual dyestuffs required. It was, however, only fair to say that licences to import had been freely granted to a consumer who furnished evidence that a specific substance was unsatisfactory for a particular purpose. German dyes could be purchased at very much lower prices than those charged for corresponding colours made in Britain. It was difficult to understand why the price of dyes should still be so high. He could not confirm the statement that Germany was charging exorbitant prices for colours not made in this country, but it was, of course, a matter of conjecture what prices would have been charged for dyes generally had there been no competition. Notwithstanding complaints, licences had been granted for quite a large proportion of the colours applied for under the Dyestuffs Act. The position of colour-users could not be considered unsatisfactory to-day, as they could draw upon many sources, viz., (1) British dyes, (2) Reparation and Treaty dyes, (3) colours obtained under licence, (4) Colour Users' Association's stock, and (5) stocks held by dealers and agents. Quite a number of British-made dyes, not hitherto made in this country, had been introduced during the past year, and many others had been improved.

Referring to the British Dyestuffs Corporation, Mr. Hoegger suggested, with all respect, that the sooner a manager possessed of the best possible chemical knowledge, technical training and experience in the dye-making industry was put at the head of affairs, the better it would be for all colour-users and for the shareholders of the Corporation. The success of the German and Swiss colour works was due entirely to having men at the head who were unexcelled in technical training and experience. The retention of our supremacy in the textile trades demanded that every effort should be made to perfect our dye-making industry; already far too many orders for dyed yarns and cloth and printed calicoes were going to Continental firms, and that entailed a loss to thousands of British workers.

During 1921 this company earned a trading profit of £349,500, compared with £425,300 in 1920, and gross earnings were £95,600 lower at £417,700. Stocks were reduced by £485,100 to £862,800, and the reserve has been increased to £950,000, all of which is invested outside the business. The dividend for the year on the ordinary shares is 10 per cent., as against 15 per cent. for 1920.

THE BRITISH OIL AND CAKE MILLS, LTD.—In 1921 this company made a net profit of £323,583, which has only been exceeded in the years 1919 and 1920. Liquid assets total £2,131,000 and current liabilities £916,000. The issued capital is £2,500,000 in £1 shares, upon which 10 per cent. was paid for the year, and £743,103 in 5½ per cent. cumulative preference shares; debentures 4½ per cent., £598,000. The financial position is very good in spite of recent adverse trading conditions. The only unfortunate section of the company's business, said the chairman, Mr. J. W. Pearson, at the meeting held in London on June 1, was the margarine subsidiary, but all manufacturers of this substance had felt the depression. The total consumption of margarine in the United Kingdom was probably not one-half that reached during the war, viz., 9000 tons per week. The soap factory, the company's

most recent extension, had done well, and its capacity had been doubled.

FANTI CONSOLIDATED, LTD.—At the meeting held on May 16, Mr. Edmund Davis, chairman, referred at length to the company's manganese properties in the Gold Coast Colony. The contract entered into in 1919 for the sale of 500,000 tons of ore at a guaranteed minimum profit of 7s. 6d. per ton has been cancelled. The property, however, is being opened up, and a production of 70,000–100,000 t. per annum is in sight. The business is much handicapped by distance from markets and excessive charges for rail transport and lighterage. The amount of detrital ore available is estimated at 3 million tons, and with the washing plant in use the manganese content has been raised from 43 to 54 per cent. In the chairman's opinion the manganese properties are worth far more than the issued capital of the company.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for May 25 and June 1.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REFERENCE NUMBER.
Australia	Iron and steel	623
"	Glassware, crockery	"
British India	Steel, commercial sodium nitrate (tender for)	3739/4 T.G.
British India, Burma, Ceylon	Rubber goods	631
Bulgaria	Cresote, zinc chloride (tender for)	8269/F.E./C.P.
Canada	Proprietary drugs	587
"	Glass and glassware	225/20 F.G./A./M.C.
Mexico	Tinplate, galvalised sheets	620
"	Sodium, ammonium and potassium compounds, ammonia, borax, boric, carbolic and tartaric acids, palm oil, talc, soapstone	621
South Africa	Disinfectant powders (tender for)	8738/E.D./C.P.
Spain	Artificial silk	600
"	Lubricating oil	601
"	Silver paper, cocoa, butter, vanilla	602
Turkey	Sugar, leather	604
United States	Laundry blue (ultramarine)	609
"	Linseed oil	610, 616
"	Tiles	611
"	Pig Iron	15622/F.W./E.C.2.

* Com./3692. Official Secretary, Commercial Bureau, Australia House, Strand, London, W.C.2.

TARIFF. CUSTOMS. EXCISE.

British Honduras.—The export duty on chicle has been reduced from 3 to 1½ cents per lb.

Canada.—It is proposed under the new Budget to reduce certain of the *ad valorem* duties under the British preferential tariff, to increase the British preference on refined sugar from 25 per cent. to 33½ per cent., and to raise the sales tax on imported goods and home manufactures by 50 per cent.

Dutch East Indies.—Revised import duties are applied to chloral hydrate, sulphuric and acetic ethers, chloroform, collodion, and other products derived from alcohol.

Egypt.—Revised tariff valuations have been issued for use in assessing the customs duties on non-ferrous metals. An open general licence has been issued for exports of fertilisers and sugar. The import duty on alcoholic liquors is fixed as follows:—Liquors containing less than 50 per cent. by volume of absolute alcohol, 10 millièmes per litre; liquors containing over 50 per cent. by volume of absolute alcohol, 200 mill. per litre; alcoholic perfumery, 170 mill. per litre; denatured spirits, 3 mill. per kg. In addition to the import duty a consumption duty of 2 per cent. *ad valorem* is imposed on ammonia, mineral lubricating oil, hydrochloric and sulphuric acids, castor and colza oils, turpentine, asphalt, pitch, lead, zinc, and window glass.

France.—From May 17 the duty on lead containing less than 25 g. of silver per 100 kg. will be increased from 3·50 to 7·70 francs per 100 kg. The duty on imported clinical thermometers has been fixed at 1 franc and 0·50 fr. each, under the "general" and "minimum" tariffs respectively.

Germany.—Increased import duties are payable on electric lamps, arc-lamp carbons, incandescent gas mantles, matches, sugar, spirits, vinegar, acetic acid, ether, perfumery and cosmetics. A licence is no longer required for imports of aluminium waste. The import duty on scrap iron has been suspended.

Latvia.—The customs tariff is being revised.

Madagascar.—The regulations controlling the sealing and marking of Madagascar graphite according to its purity have been revised. A copy of the regulations may be consulted at the Department.

New Zealand.—All manures are now free of import duty.

Poland.—Aceto-arsenite of copper is admitted free of duty, but a surtax of 900 per cent. is payable on fertilisers, train oil, various vegetable oils, butter substitutes, graphite, antimony, nitric acid, lead blocks, and cellulose. A surtax of 4900 per cent. is applied to wax, asbestos, various ceramic products, glass, certain coal-tar products and organic chemicals, rare-earth compounds, metal products, paper, sulphuric ether, bleaching powder, acetate of lime, tanning extracts, and pigments for artists' colours.

Rumania.—Increased import duties are payable on sheet and plate glass, coal, coke, iron sheets, tinplate, metal in leaves or powder, caustic soda, alum, calcium chloride, chloride of lime, sodium silicate, soda, soda ash, sodium sulphide, borax, pure calcium phosphate.

Sweden.—The monopoly of the importation of sugar has been prolonged until June 30, 1923. Legislation is proposed to prevent "dumping."

United States.—All imported articles and packages are required to be marked in legible English words, with the name of the country of origin.

PASTEUR CENTENARY EXHIBITION.—The Department of Overseas Trade has received copies of the regulations of the Exhibition of Industrial and Scientific Hygiene to be held at Strasbourg from June to October, 1923, in celebration of the centenary of Pasteur's birth (*cf. J.*, 1922, 111 *u*). The exhibits will be classed under ten headings, which cover numerous sections such as bacteriology, vaccination, chemistry, chemical and pharmaceutical products, antiseptics, hygiene, food products, and agriculture. Copies of the list of exhibits (in French) may be obtained from the Department.

REPORTS.

REPORT ON THE ECONOMIC AND FINANCIAL CONDITIONS IN GUATEMALA, DATED FEBRUARY, 1922. By G. L. ROGERS, *H.M. Vice-Consul, Guatemala. Department of Overseas Trade.* Pp. 35. London: *H.M. Stationery Office.* 1922. Price 1s.

Guatemala has a population of 1,600,535, and an area of 42,456 sq. miles, about two-thirds of which is mountainous and one-third low-lying and tropical. The staple products are coffee, sugar, chicle, bananas, timber, coconuts, hides, skins, rubber, honey, and beans; rice and cotton are grown for local consumption. Coffee of fine quality is produced, and the sugar industry, which is largely under British control, has increased its output more than threefold since 1910. Mahogany and cedar are the chief timbers, but vast areas of virgin forest are still unexplored. Production of chicle, the raw material of chewing gum, is a monopoly of Guatemala. An American company is attempting to introduce the silk industry into the country. Enormous tracts of land are still uncultivated, but the fertile coast-lands will produce almost any tropical product and the highlands could produce cereals for export. Lack of capital, shortage of labour, and the absence of transport facilities are impeding development. At present only a few small silver and lead mines are being worked, and, although there are said to be promising indications of the presence of petroleum, no drilling operations have yet been undertaken. The lower cretaceous deposits at Coban in the East Verapaz district are stated to be saturated with bitumen.

The exports in 1921 were valued at \$12,130,890 (U.S. gold), and included:—Honey 277 long tons; coffee (clean) 41,770·4 t.; sugar 6577·1 t.; chicle 356·8 t.; wax 6·6 t.; skins 27·6 t.; gold 571·9 fine oz.; minerals 590·7 t. Imports, worth \$10,690,085, comprised:—Glass, porcelain, and earthenware 679·2 metric tons; paper 976·8 t.; and drugs and pharmaceutical supplies 493·2 t. The percentage derivation of the imports in 1920 and 1921 was as follows:—United States 65, 61; United Kingdom 21·7, 17·8; Germany 4·2, 10·4%. Germany, aided by the low exchange rate of the mark, has gained substantially in almost every branch of trade, and during 1922 she will probably regain her pre-war position; in 1913, 20·5 per cent. of the imports was of German origin.

REPORT ON THE TRADE AND INDUSTRIAL RESOURCES OF NEWFOUNDLAND, DATED DECEMBER, 1921. By CAPT. E. J. EDWARDS, *H.M. Late Senior Trade Commissioner in Canada and Newfoundland. Department of Overseas Trade.* Pp. 25. London: *H.M. Stationery Office.* 1922. Price 9d.

With the exception of the hæmatite mines at Bell Island, the mineral resources of Newfoundland have been but little developed. The present report contains a considerable amount of information concerning these resources, the extent of which has been re-estimated on a conservative basis.

Although there is an immense amount of coal in the Colony, the seams that are exploitable will probably not yield more than two million tons. Oil seepages occur at various points on the West Coast, and numerous borings have been sunk, but no flowing well has been struck, and owing to the contortion of the geological formation, the chance of tapping an important oilfield is considered remote. On the other hand, oil-shales extend over approximately 500 sq. miles, certain of the numerous workable beds have yielded 16 gallons of oil per ton on distillation, and commercial exploitation is probable. The iron-ore deposit on Bell Island is the third largest of its kind in the

world. Other deposits of hæmatite have been located, but their commercial value has not been proved. An enormous deposit of magnetite, with 50–60 per cent. of iron and 2–12 per cent. of titanium, occurs at Bay St. George, and is said to contain about 750,000 t. of proved ore. Other magnetite deposits occur at Stephenville, Portland Canal and Notre Dame Bay. There are large areas of copper-bearing rocks of considerable promise, and although no ore is being extracted at present, about 3 million tons of high-grade ore has been won in the past. Lead ores, most of which are argentiferous, occur in various districts and some of these deposits are probably of commercial value. The chief deposit, at the La Manche mine in Placentia Bay, was worked extensively sixty years ago. Other minerals which probably occur in workable quantities are chromite, manganese ore, molybdenite, gold, slate, talc, clay, limestone and felspar. It is suggested that the large areas of chrome-bearing rocks may be found to contain platinum. Investigation has shown that chrome iron ore containing 50 per cent. of chromium sesquioxide is available.

The value of the exports in the year ended June 30, 1921, was \$22,441,267 and that of the imports \$28,909,727, decreases of \$12,424,171 and \$11,623,661, respectively, compared with 1919-20. Of the exports, the United Kingdom took 28·4, Portugal 16·8, Brazil 10·1, Canada 8·8 and the United States 8·3 per cent.; and of the imports, Canada supplied 51·3, the United States 33·1 and the United Kingdom 11·2 per cent. Owing to the absence of a preferential tariff, goods from the United Kingdom cost more than those from the United States, but steps are being taken to rectify this anomaly.

LEGAL INTELLIGENCE.

RAILWAY TRANSPORT OF HYDROGEN PEROXIDE.—*Great Northern Railway Co. v. L.E.P. Transport and Depository, Ltd.*

On May 18, in the Court of Appeal, Lords Justices Bankes, Scrutton and Atkin began the hearing of an appeal by the Great Northern Railway Co. against the L.E.P. Transport and Depository, Ltd., from the judgment of Mr. Justice Horridge, and the cross-appeal by the Transport Co. from the same judgment. Mr. Justice Horridge found that the railway company had to carry the goods (hydrogen peroxide in glass carboys); that the goods were dangerous; and that there was a breach of warranty by the defendant company. (*Cf. J.*, 1922, 36 R.)

Counsel for the railway company argued that as common carriers they were under legal liability to indemnify the owner of the hats which had been damaged by the "oxygenated water," and that there was no authority anywhere which laid down that the mere fact of entering into a special limited contract took away the character of common carriers. If the Court agreed with Mr. Justice Horridge that the railway company were not common carriers of the hats there was vested in them nevertheless all the liabilities of public carriers. He submitted that the Transport Co. had been guilty of breach of warranty, and that the natural result of the breach was the damages paid by the railway company to the owner of the hats. He asked, therefore, for the amount so paid.

For the Transport Co. it was submitted that the judgment of Mr. Justice Horridge was right on the question of liability. The special contract terms

under which the railway company agreed to carry the hats were inconsistent with their liability as common carriers, and that so far as those goods were concerned they had never assumed liability as common carriers. The defendant company had accurately described the goods as hydrogen-peroxide solution, and the fact that the solution turned out to be stronger than anticipated could not be held to imply a warranty that the goods were not dangerous.

Lord Justice Bankes, in giving judgment on May 24, said that the action presented the curious and unusual feature of a railway company, contrary to all previous experience, contending that they were common carriers of the felt hat-bodies, in spite of the fact that the goods were carried under a special contract entered into with the consigner. He came to the conclusion that the railway company were common carriers of the felt goods, and that there was nothing in their special contract which obliterated or destroyed their character as such. Therefore the railway company was under a legal liability to pay the consignor of the felt goods for the damage done to those goods. Upon that part of the case he disagreed with the judgment of Mr. Justice Horridge. Upon the cross-appeal, he agreed with the judge that there was an implied warranty by the Transport Co. that the chemical goods were not dangerous. He agreed that the railway company were not common carriers of the carboys, but that the goods were carried by the railway company under a statutory duty. In his view an implied warranty did attach to goods carried under a statutory duty. In these circumstances the plaintiffs' appeal must be allowed with costs, and the defendants' cross-appeal dismissed with costs, and judgment entered for the plaintiffs for the sum claimed, £437, with costs. Lords Justices Scrutton and Atkin concurred.

REVIEWS.

A DICTIONARY OF APPLIED CHEMISTRY, VOL. III. EXPLOSIVES — K. By SIR EDWARD THORPE. Revised and enlarged edition. Pp. viii+735. (London: Longmans, Green and Co. 1922.) Price 60s. net.

Amongst principles which are the most difficult for the public mind to grasp is the inter-relationship of science and industry, carrying with it the dependence of industrial progress on the patient elaboration of that new knowledge which alone extends and consolidates the foundations of such progress. Thorpe's Dictionary presents a shining example of this principle, for here are interwoven a mass of detailed scientific observation with concrete industrial achievement, providing abundant matter of direct interest to chemists, whatsoever the branch of activity they may pursue, and simultaneously affording much information to the lay reader in a form sufficiently non-technical to be palatable.

The ten years elapsing since publication of the previous edition have added so much to the practical knowledge of explosives that it has been necessary to extend the first article in the present volume, which deals with that subject in a comprehensive manner. Fermentation, including the chemical action of enzymes and bacteria, is also admirably treated, whilst the article on glucosides now includes a general survey of the laboratory products as introduction to the description of those derived from vegetable sources. Glass, fuel and coal-gas receive the attention their importance deserves, and a welcome addition to the former volume is an

article on hardened, or hydrogenated oils, necessarily dealing with much recent work.

Unqualified praise must be given in recognition of the production and arrangement; the labour involved in selecting material for presentation reveals itself only on close examination, and must have been immense. A few unimportant examples of overlapping, in any case most difficult to avoid, occur in connexion with aminoguanidine (pp. 475 and 537), flavanthrene (pp. 216 and 593) and isinglass (pp. 367, 419 and 685), whilst the desirability of using the word "hydrazones" to embrace both arylhydrazones and hydrazones proper may be questioned; many representatives of the latter class have been described during the past ten years and are necessarily distinguished from arylhydrazones by their chemical activities. In a treatise on applied chemistry one expects to find Naphthol AS and AN, new materials of increasing applicability, but these are missing from the paragraph on 2-hydroxy-3-naphthoic acid; similarly, rongalite is not included amongst formaldehyde derivatives, whilst Hydrone Blue, although mentioned in the text, is not accorded an alphabetical reference. It would have been useful to indicate the British equivalents for indanthrene, namely, the duranthrene and caledon colours, as notable examples of the attempts now being made to establish a domestic dye-making industry, more particularly as they are not given in Vol. II., but all these points are relatively small matters which do not affect the outstanding value of the work.

M. O. FORSTER.

THE VITAMINS. By PROF. H. C. SHERMAN and S. L. SMITH. *American Chemical Society: Monograph Series.* Pp. iii+273. (New York: Chemical Catalog Co, Inc. 1922.) Price \$4 net.

Interest in the subject of Vitamins continues unabated and a number of works has now been published on the question. The present contribution contains an admirably clear account of what is known of the properties and functions of these still mysterious principles. After a historical introduction in which it is shown how the existence of Vitamins forced itself on the minds of investigators in quite independent fields of research on growth and on what are now termed the deficiency diseases, the subject matter falls naturally into three chapters, one devoted to each of the recognised Vitamins, A, B and C. A final chapter deals with Vitamins in the problem of food supply and is enriched by the authors' experience and knowledge of the general science of nutrition.

The mass of experimental work already accomplished on the Vitamins—the excellent bibliography appended to the present work contains about a thousand entries—has only served to reveal the many problems with which the subject is surrounded; scarcely one of these has as yet been satisfactorily solved. Their chemical nature is as little known as that of the enzymes, the toxins and the antitoxins, which have been known to science for a much longer period. All these elusive entities have in common the fact that they are present in exceedingly minute quantities, a circumstance which adds greatly to the difficulty of their isolation. Very little progress has been made in this direction. The conditions of inactivation have indeed been ascertained with some accuracy so that a rational choice of methods has become possible. We now know for example that Vitamin A, although associated in the animal body with fat, is not itself a fat, but, when the fat is hydrolysed in absence of air, is found with unabated potency in the unsaponifiable matter. As this amounts to

about 1 or 2 per cent. of the fat in such a rich source of the Vitamin as cod-liver oil, and, further, as the greater part of it consists of cholesterol, it is obvious that the proportion of Vitamin in the oil must be very small indeed, although as little as 1.2 mg. of the oil has been found to supply sufficient for the daily wants of a young rat. Similar, but not quite so striking, relations hold with regard to the other two Vitamins, and the prospects of isolation do not appear at the moment to be particularly bright.

The origin of the Vitamins is another vexed question which receives a considerable amount of attention in the work under consideration. That of Vitamin A seems to be definitely connected with the photosynthetic processes in plants; Vitamin B occurs very largely in yeast, as well as in green plants and seeds, but the experimental evidence as to whether this organism actually produces the Vitamin or merely takes it up from the vegetable concoctions in which it is grown is still conflicting. Finally the antiscorbutic or C Vitamin is known to arise when seeds germinate, but nothing is known of the production or nature of the antecedent pro-vitamin or of the nature of the process by which the one passes into the other.

Matters of great practical interest arise in connexion with the treatment of foodstuffs in preparation for the market or for consumption. Cooking, it may now be said with some certainty, mainly affects Vitamin C, but the extent to which it affects it depends on many factors, such as temperature, time, acidity, exposure to oxidation, and nature of the material. Thus the Vitamin C of cabbage appears to be more readily inactivated both by cooking and drying than that of lemon or tomato juice, and this even when the acidity is adjusted. Dried vegetables have in fact been found to be more deficient in Vitamin C than dried fruit juices, and a method of drying vegetables which will conserve their vitamins is very much to be desired. Vitamins B and A do not appear to be greatly influenced by ordinary processes of drying or cooking. In all these cases, however, as the author wisely points out, it is unsafe to generalise, and detailed investigation of each material is required. This is specially necessary for the foodstuffs employed in feeding animals, as it has been abundantly demonstrated, both here and in America, that the Vitamin value of animal products depends largely on the diet. Milk, the staple food of children, has been repeatedly shown to vary greatly in Vitamin content according to the feed of the cow, and an urgent necessity is the proper investigation of the materials fed to cattle during the winter months, when fresh fodder is unprocurable, so that a rational diet may be devised on which the winter milk will be as valuable as regards Vitamins as that produced in summer.

Perhaps the most interesting development of the Vitamin problem is the remarkable effect of light in curing or preventing rickets in children and rats fed on diets deficient in calcium or phosphorus and Vitamin A. The full establishment of the facts, however, came too late for inclusion in the present book, which only contains a brief reference to the early work on the subject.

It will be seen that the authors have provided a most interesting and valuable account of their subject which can be strongly recommended to all who are concerned—and who is not?—with the question, either for personal, scientific or industrial reasons.

A. HARDEN.

"The British Association for the Advancement of Science: A Retrospect, 1831—1921," has been written by the Secretary, Mr. O. J. R. Howarth, and published by the Association, price 7s. 6d. net.

PUBLICATIONS RECEIVED.

METALLOGRAPHY. By PROF. C. H. DESCH, *Text-books of Physical Chemistry. Third edition. Pp. 440. (London: Longmans, Green and Co. 1922). Price 16s.*

DYES CLASSIFIED BY INTERMEDIATES. By R. N. SHREVE, W. N. WATSON, and A. R. WILLIS. Pp. 631. (New York: The Chemical Catalog Co., Inc. 1922). Price \$10.

THE DETERMINATION OF SULPHUR IN IRON AND STEEL, WITH A BIBLIOGRAPHY. 1797—1921. By H. B. PULSIFER. Pp. 160. (Easton, Pa.: The Chemical Publishing Co.; London: Williams and Norgate. 1922.) Price \$2.50.

THE CORROSION OF IRON. By DR. J. NEWTON FRIEND. *Carnegie Scholarship Memoirs. Vol. XI. Pp. 161. Published by the Iron and Steel Institute, 28, Victoria Street, London, S.W. 1. 1922.*

INDUSTRIAL NITROGEN. By P. H. S. KEMPTON. *Pitman's Technical Primer Series. Pp. 104. (London: Sir Isaac Pitman and Sons, Ltd. 1922). Price 2s. 6d.*

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THE TECHNICAL SYNTHESIS OF NITRIC ACID BY MEANS OF GASEOUS EXPLOSIONS.

F. HÄUSSER.*

The success of the Haber-Bosch process for synthesising ammonia from atmospheric nitrogen and also the wide development of the cyanamide process are well known; but these processes are very complicated if the nitrogen be required in the form of nitric acid.

The cyanamide process involves five stages:— (1) The manufacture of calcium carbide; (2) separation of pure nitrogen from the air; (3) reaction of nitrogen with calcium carbide; (4) hydrolysis of the cyanamide; and (5) oxidation of the resulting ammonia to nitric acid. In the Haber-Bosch process the same result is attained in four stages, viz., (1) preparation of the nitrogen-hydrogen mixture in a gas producer, (2) interaction of carbon monoxide and steam, and very complete purification of the gases, (3) catalytic synthesis of ammonia in high-pressure vessels, and (4) oxidation of the ammonia. This process is somewhat simpler, but it involves great wear and tear of the high-pressure apparatus used for the heated hydrogen-nitrogen mixture.

On account of its simplicity the explosion process contrasts favourably with the above two processes. It proceeds directly from nitrogen to nitric acid and, apart from the removal of sulphur, the gases require no special purification. There is, moreover,

the yield at any temperature being given by van't Hoff's equation:—

$$\frac{d \log_e K}{dT} = -\frac{Q}{RT^2} \dots\dots\dots (5)$$

in which Q is the heat of reaction, R the gas constant, T the absolute temperature of the reaction, and K the equilibrium constant, the value of which, according to equation (1), is given by the expression:—

$$K = \frac{(NO)^2}{(N_2 - NO/2)(O_2 - NO/2)} \dots\dots\dots (6)$$

in which (NO) is the percentage by volume of nitric oxide, and (N_2) and (O_2) are the original percentages of nitrogen and oxygen, respectively. For the heat of reaction the equation

$$\frac{dQ}{dT} = c - c',$$

holds good, where c and $c - c'$ are the specific heats of the gases before and after the reaction. As all the other physical properties of nitric oxide are in keeping with those of a perfect gas, its specific heat may be taken as the same function of the temperature as that of nitrogen and oxygen. Therefore

$dQ/dT = 0$, or $Q = Q_0 = -2 \times 21,600$ cal./mol.; further, $R = 1.99$ cal./mol.

According to Nernst the equilibrium constant K for nitric oxide is 0.74×10^{-4} at 1811° abs., so that equation (5) becomes

$$\log_{10} K + \frac{9424}{T} = 1.07 \dots\dots\dots (7)$$

TABLE I.

	Pressure and Temperature.		Exit gas. Content in vol. per cent.				
	Before explosion.	Of explosion.	Oxygen.	Nitrogen.	Nitric oxide.		Nitric-acid yield in gm. per cb. m. of gas.
					Calculated from (7).	Found.	
Test with small bomb (552 c.c. capacity). Mixture of air with 14.5% of coal gas	3.00 kg./cm. ² abs. 286° abs.	21.6 kg./cm. ² abs. 2130° abs.	1.95	70.0	0.24	0.27	47.6 g.
Test with large bomb (1651 c.c. capacity). Mixture of air with 13.5% of coal gas	3.58 kg./cm. ² abs. 290° abs.	25.4 kg./cm. ² abs. 2110° abs.	3.2	70.8	0.29	0.54	99.5 g.
Air with 25% carbon monoxide ..	3.57 kg./cm. ² abs. 292° abs.	23.1 kg./cm. ² abs. 2140° abs.	4.5	63.1	0.37	0.80	75.2 g.

less wear and tear on the apparatus, which is much simpler than that required in the arc process.

Theory and Laboratory Research.

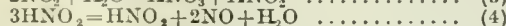
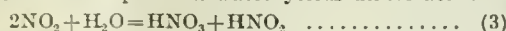
Nitrogen and oxygen combine at a high temperature to form nitric oxide:—



the nitric oxide formed being obtained unchanged by rapidly cooling the reaction mixture. This nitric oxide undergoes spontaneous oxidation to peroxide:—



which on absorption in water yields dilute acid:—



From an economic standpoint, reaction (1), i.e., the yield of nitric oxide, is the determining factor. This reaction in an exploding mixture of gas and air may be considered as a simple thermal reaction,

Equations (6) and (7) give the maximum yield of nitric oxide in an exploding gas mixture, T being the temperature of the explosion, and (N_2) and (O_2) the initial concentrations of nitrogen and hydrogen, it being assumed that the reaction is purely thermal.

The older experiments of Bunsen and Finckh on the formation of nitric oxide in an exploding mixture of oxyhydrogen gas and air do not suffice to test this theory. The writer has therefore carried out tests on compressed mixtures of air with coal gas and air with carbon monoxide, in the first place in a small bomb of 552 c.c. capacity, the assumption being made that the cooling of the walls of the vessel after the explosion was sufficiently rapid to prevent decomposition of the nitric oxide. The trials were afterwards repeated in a bomb of 1651 c.c. capacity, in which changes in the equilibrium mixture after the explosion were avoided by quickly cooling the gases with a water spray.

Trials conducted without cooling gave 15–30 per cent. lower yields. The spray was produced by a water cylinder provided with a piston operated by

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a falling weight, which also made contact in the ignition circuit, so that ignition, explosion and spraying occurred at definite intervals. Fig. 1 shows the whole arrangement. The results summarised in Table I. (cf. previous page) were confirmed by another worker.

The experiments show that the yields increase with the size of bomb: whereas with the smaller bomb, theory and experiment agreed fairly well, with the larger one the yields were 90–120 per cent. above the theoretical.

The original work¹ must be consulted for a discussion of these results, which are in agreement with those of Haber and König,² who obtained yields of nitric oxide in cooled high-tension arcs far higher than those calculated on a purely thermal equilibrium.

Technical Researches.

On passing from laboratory experiments to work on a larger scale, the injection of a water spray was abandoned as it caused severe corrosion. The rapid cooling required by theory was obtained by allowing the gases from the bomb to expand immediately after the explosion. To obtain a good yield the use of a pure gaseous mixture is essential; even slight traces of the exhaust gases lower the temperature of the explosion and greatly diminish the yield. To this end the contents of the bomb were swept out with air.

The first experimental plant (Fig. 2) consisted of a specially designed compressor with a bomb of 100 litres capacity attached to it. A few revolutions of the compressor suffice to charge the bomb with

exhaust gas containing 8–9 g. of nitric acid per cb. m. No trouble was experienced with the material of the bomb, and the exhaust-valve remained tight. The connexion between the compressor and bomb was not suitable for continuous working, and accordingly the plant was converted into a self-contained machine with its own drive (Fig. 3), similar to the later bombs used in the works' experiments. The nitric oxide had, however, still to be recovered as nitric acid.

TABLE II.
Experimental Results.

Excess pressure (approx.).	Ignitions per min.	Degree of preheating of air.	Oxygen added per cb. m. of coal gas.	Nitric acid in exhaust gas, in g. per cb. m.*
About 3 kg./cm. ²	14–15	Nil.	Nil.	9–10 g.
" 4 " "	28	250°–300° C.	Nil.	11–12 g.
" 3 " "	14–15	Nil.	0.33 cb. m.	17–18 g.

* These figures refer to the volume of the exit gas at air temperature, after separation of the water produced by the combustion.

These tests showed the great importance of a thorough mixing and complete combustion of the gas. The yield decreases if the combustion be incomplete, the carbon monoxide formed presumably reducing nitric oxide: $\text{NO} + \text{CO} = \text{N} + \text{CO}_2$.

Corrosion of materials and other difficulties did not occur, and the water-cooled exhaust-valve of the bomb stood very well. Pre-ignition, which

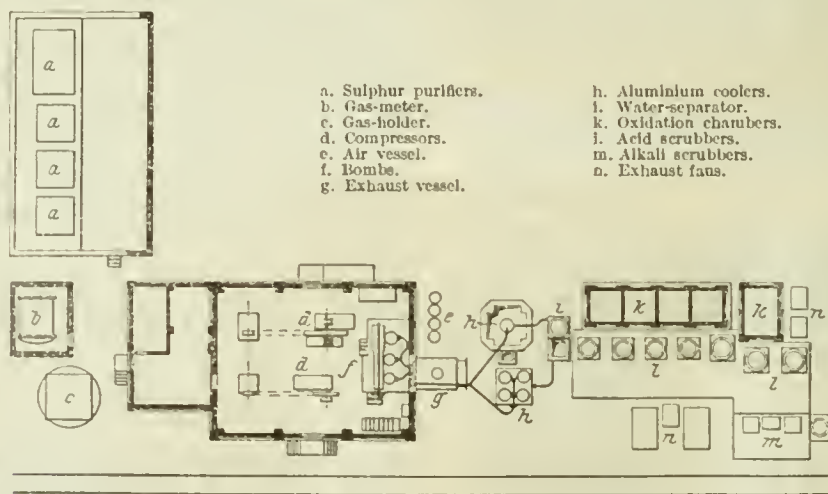


FIG. 4.
Plan of Experimental Works.

gas and air; during the explosion and the opening of the exhaust, the compressor is out of action, and then it is used to scavenge the bomb with pure air. The cycle is then repeated. In this way the bomb was worked at the rate of 6–10 ignitions per minute. The object of the tests was to ascertain if the chemical process taking place in the bomb could be controlled by mechanical means, and if the apparatus could deliver a constant stream of nitric oxide.

After some initial failures, complete control was obtained over the production of nitric oxide; the machine worked on coal gas and delivered an

had been guarded against by providing the bomb with a safety diaphragm, did not occur, even with runs of six and eight hours, and with the higher temperatures produced by adding oxygen. This fact is important because, when works' trials were started, pre-ignitions occurred so frequently that operations were brought to a standstill.

Works' Trials.

After the preliminary work described above, and shortly before the war, a trial plant for the production of nitric acid was erected in connexion with a battery of coke ovens in Westphalia. This plant at first consumed 5000 cb. m. of coke-oven gas per 24 hrs., and subsequently 7000 cb. m. The gas,

¹ Z. des Vereins deutscher Ing., 1912, p. 1157.

² Z. Electrochem., 1907, 13, p. 725; 1908, 14, p. 689.



Fig. 1.—Experimental Apparatus.

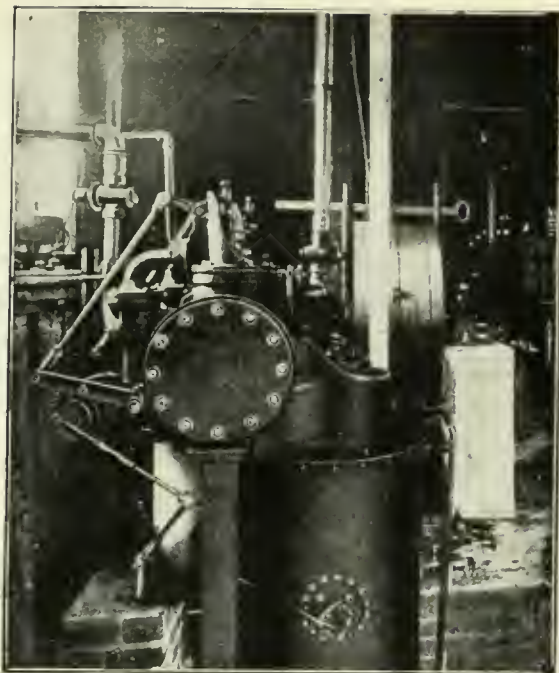


Fig. 2.—The First Experimental Plant.
The Explosion Compressor.

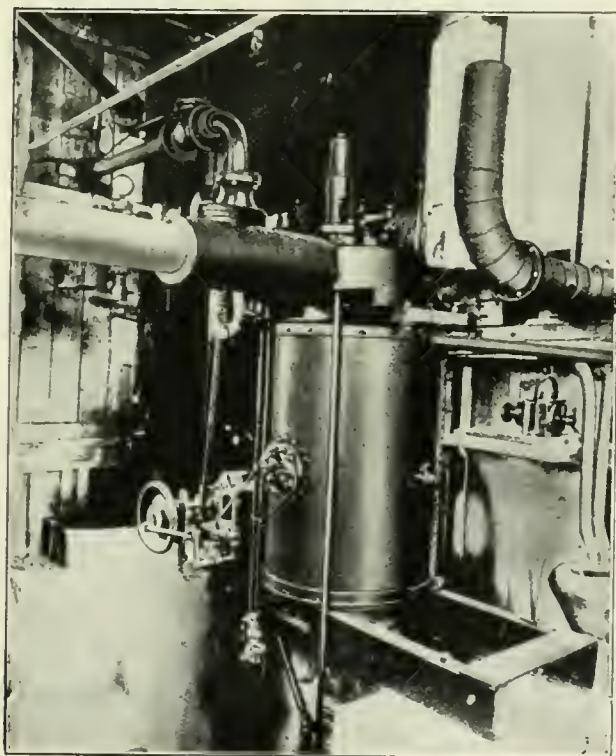


Fig. 3.—The First Explosion Bomb.

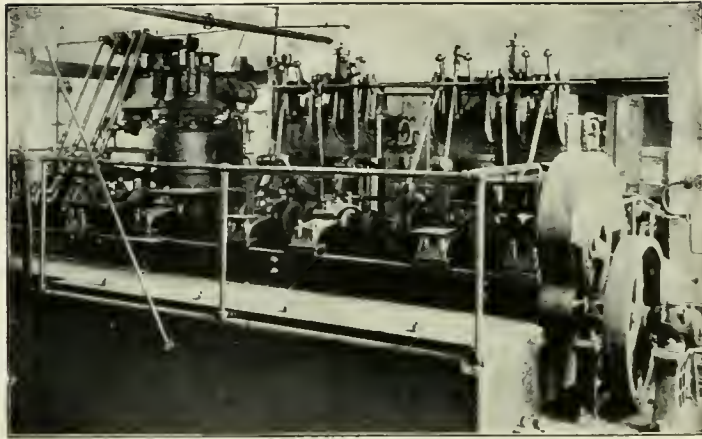


Fig. 5.—The Bombs in the Works' Plant.

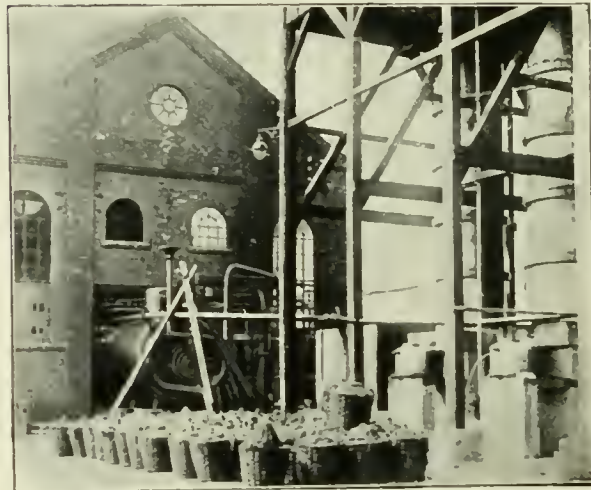


Fig. 6.—Exhaust Vessel, Pressure Vessel and Cooler.

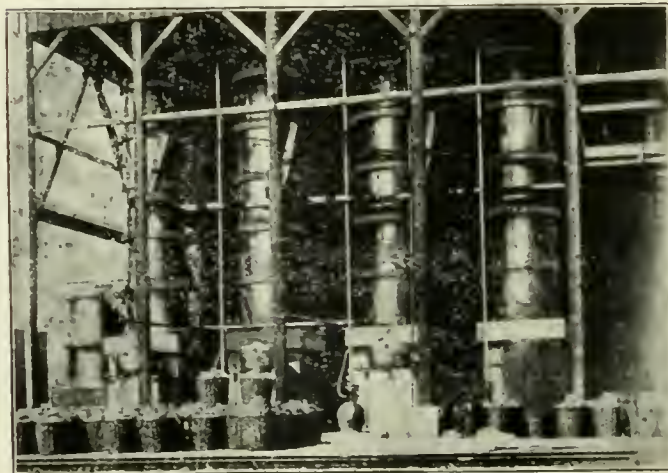


Fig. 7.—Water Separator and Absorption Plant.

which had a calorific value of 3800—4000 heat units per cb. m. (at times only 3300—3500 heat units) was drawn from beyond the benzol plant, i.e., after separation of the usual by-products, tar, ammonia and benzol. Nitric acid, therefore, figured as an additional member of the by-product series. Fig. 4 shows the plant in its final form. Fig. 5 shows, on the right, the first two bombs of 100-litre capacity, on the left, the later 300-litre unit. Fig. 6 shows the exhaust vessel with fume-cover removed, behind it is the air-vessel, and the aluminium cooler, afterwards supplemented by a second. Fig. 7 shows the water-separator for removing the water of combustion, and the absorption system (of 4 acid-towers in the original plant) with the oxidation chambers behind them.

The process can readily be followed from these illustrations. The gas is freed from sulphur in cleaning boxes, passed through a meter to a small gas-holder, and then forced into the gas-chamber by the compressor. The air is forced into the air-vessel and thence to the bombs after being preheated to 300° C. in the superheater coil which passes through the tube of the exhaust-vessel. The gas and air are compressed to 5.5—6.0 kg./cm². Afterwards the bomb is scavenged with air at 0.75 kg./cm² which passes to a separate vessel. A Linde oxygen-plant was originally provided to enrich the air, but was disconnected later. It was found that the lower nitric-oxide content of the exhaust gases produced with ordinary air was sufficient to give a suitable strength of acid. *By omitting the addition of oxygen the process is greatly simplified.*

The explosion-bombs, which are fitted with specially designed inlet-valves, are filled with the gas mixture by the pressure-vessels in such a way that mixing takes place as the gases enter the bomb. Back-pressure valves prevent an excess of air and gas entering the pressure-vessel and avoid any danger of mixing taking place outside the bombs. A lead membrane ensures safety in case of pre-ignition, which must not be allowed to occur in the inlet tubes as it does in a gas-engine. The lead diaphragm is held in a sliding frame which enables it to be changed, if blown out, without interrupting the process.

The inlet-valve closes as soon as the bomb is full. The usual Bosch ignition is employed, and the exhaust-valve opens approximately 0.15 sec. after the explosion. Fig. 8 gives the variations of pressure in the bomb; the explosion pressure rises to 22—25 kg./cm².

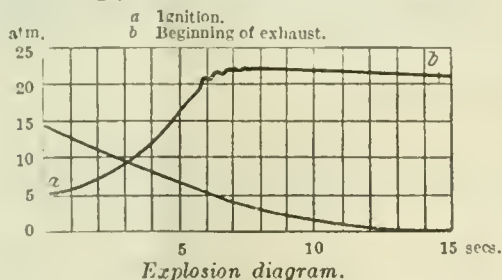


FIG. 8.

After the exhaust, the special connexion in the inlet-valve for scavenging the combustion gases opens, then the exhaust- and air-valves close, and the sequence begins anew. In each bomb there are 44—45 ignitions per minute.

The exhaust gases pass through the fire-tube of a marine-boiler, in which they are cooled to about 250° C. Up to this stage only iron apparatus is used, as nitric oxide does not affect it. After leaving the boiler, the temperature of the exit-gases is reduced to that of water in aluminium coolers, so that the water of combustion condenses. The con-

densate is separated from the gases in a small acid-resisting tower—the water-separator—and contains only 0.5 g. HNO₃ per litre; it is neutralised with lime and run into the drains.

From the water-separator the gases pass to the absorption system. This differs from the usual series of large absorption towers in that it has separate oxidation- and absorption-chambers through which the gases pass alternately.

Water-separator and Absorption-plant.

At first four scrubbing-towers were provided, but these were found to be quite insufficient, and three more were added. Following this series are two towers of sheet iron, in which the residual oxides of nitrogen are treated with soda solution for the production of nitrate. The absorption obtained in the final form of the plant was satisfactory. With both 100-litre bombs working, a gas was produced containing on the average 12 g. of nitric acid per cb. m., and this was converted into 27—28% nitric acid with an exit loss of 3 g. of nitric acid per cb. m. The acid made was used in the munitions industry, at first after a high degree of concentration, later at its original strength. The soda towers yielded a 24% solution of sodium nitrite containing 0.7—0.8% sodium nitrate and some bicarbonate, which was used partly by the dyestuff industry and partly for sulphuric-acid chambers.

The greatest difficulty in this experimental plant was that of pre-ignitions, which had never occurred in the earlier technical trials. Every attempt to raise the pressure above 3 atm. in the 100-litre bombs led to this result. After prolonged investigation, it was found that the jointing material between the bomb and its connexions was partly the cause of the pre-ignition. The above-mentioned sliding diaphragm was accordingly designed, and the difficulty overcome. Another serious difficulty was that the outlet-valves of the 100-litre bombs often showed signs of wear after a few weeks, especially in the seatings, and then could not be closed tightly. In spite of these troubles, continuous day and night working was maintained so far as was possible in the absence of spare parts, no reserve material having been provided in the installation.

In order to increase the output, a bomb of 300-litre capacity was designed, the existing compressors and other plant being adequate for this addition. Owing to difficulties connected with the war, the completion of this bomb was greatly delayed; work with it was first started at the beginning of 1918 and proceeded continuously for six months, chiefly at the rate of 44—45 ignitions per minute. The plant stood the test well, especially the exhaust valve, which showed no wear on the seating after this period of use. The acid content of the exhaust gas was raised to 18.5 g. of nitric acid per cb. m. (unreduced).

Table III. gives the principal process figures for the two sizes of bombs. They represent monthly averages, except the maximum yield from the 300-litre bomb, which refers to a shorter period.

The threefold increase in the size of the bomb improved the yield about 50% and brought the nitric-oxide concentration of the exhaust gases up to 0.7%. The over-all efficiency did not show such an improvement, as the absorption of the increased volume of gas was attended by considerable loss. This occurred particularly at the joints on the exhaust-tube, which were too weak to withstand the much more violent exhaust-shocks of the large bomb, and 30% of the gas was lost in this way. Only complete rebuilding would have provided a remedy.

The varying quality of coke-oven gas can be very simply compensated by regulating the quantity of gas entering by means of a throttle-valve on the suction-pipe of the gas-compressor. The carbon-dioxide content of the exhaust gas is determined

frequently and kept uniform by regulating the feed. To supplement this rough control the nitrous gases in the exhaust are determined two or three times daily.

Development of the Process.

The use of the 300-litre bomb has made the process a technical success, and, given a moderate charge for gas and adequate utilisation of the advantages offered by collieries and coke ovens, its economic success seems assured. The compressed-air supply may be derived from a central station and thereby cheapened, since the pressure required, 6—7 kg./cm.² is a common one. If the cost of gas is high, an increase in the dimensions of the bomb affords a simple method of obtaining a higher efficiency. With a larger bomb the heat lost owing to superficial cooling of the bomb and to water-cooling is reduced relatively to the total heat content. Hence a higher temperature of explosion is obtained; and as, according to the thermal theory of nitric-oxide formation, a slight rise of temperature results in a considerable displacement of the gaseous equilibrium in the direction of nitric-oxide formation [cf. equation (7)], larger bombs may be expected to afford much higher yields. Further, the heat loss in the cooling water, which with the 300-litre bomb is 22 per cent. of the heat developed in it, can be reduced.

The increase in capacity of the bomb to 1000—1500 litres and the provision of valves and other accessories for bombs of this size would not be difficult technically, and even larger units could, doubtless, be used with success.

The bombs could probably be fired with liquid fuel instead of gas. As the air for combustion enters under an initial pressure of 6—7 kg./cm.² there would be no great difficulty in making the entering hot air atomise the oil so that complete combustion in the bomb would result. For such purpose oils of a high boiling-point, crude oil, etc. might be advantageously employed. It is to be expected that liquid fuels, by reason of their greater calorific value, would produce higher explosion temperatures than coke-oven gas in a bomb of equal dimensions, and consequently higher yields.

The process also permits a simplification of the absorption plant. As is known, the working-up of dilute nitrous gases involves large and expensive plants of acid-resisting brickwork, especially on account of the slow rate of production of nitrogen peroxide at ordinary pressures. At high pressures the reaction is much more rapid.

of nitric oxide under pressure. Apparatus capable of withstanding pressure and acid must, of course, be provided, and for this acid-resisting iron alloys, e.g., Krupp's "V₂A" steel, are suitable. This material is obtainable in many forms, either wrought or cast, is easily worked, can be autogenously welded, and was found suitable for nitric-acid plant during the war.

Appendix: Calculation of the Absorption Space Required.

The large spaces required for the absorption of dilute nitric oxide are entirely due to the low reaction velocity of the transformation



Bodenstein found the velocity constant, k , of the above reaction to average about 5.72×10^{-4} at 30° C., the concentration of the gases being measured in millimetres of α -monobromonaphthalene, and the time in minutes. If this value is converted into mols. per c.c. as concentration units and seconds of time, taking the sp. gr. of monobromonaphthalene as 1.49 and the gas constant as 82.1

$$k' = \frac{k}{60} \left(\frac{1.49}{13.59} \cdot \frac{1}{760} \cdot \frac{1}{303} \cdot \frac{1}{82.1} \right)^{-2}$$

$$\text{or } k' = 2.83 \times 10^{10}$$

Further, if

c_1 = concentration of the nitric oxide (2NO) in mols. per c.c.

c_2 = concentration of the oxygen in mols. per c.c.

x = concentration of the nitrogen peroxide (2NO₂) in mols. per c.c.

t = time in secs. for the formation of x mols. of nitrogen peroxide.

then, applying the principle of mass action to (8)

$$\frac{dx}{dt} = k'(c_1 - x)^2(c_2 - x)$$

Integrating

$$t = \frac{1}{k'} \int \frac{dx}{(c_1 - x)^2(c_2 - x)} + \text{constant.}$$

The integration constant is found by substituting $x=0$ and $t=0$, giving

$$t = \frac{1}{k'} \left[\frac{1}{(c_2 - c_1)^2} \cdot \log_e \frac{c_2}{c_1} \cdot \frac{c_1 - x}{c_2 - x} + \frac{1}{(c_2 - c_1)c_1} \cdot \frac{x}{(c_1 - x)} \right] \dots\dots (9)$$

The reaction velocity was found by Bodenstein not to be affected by nitrogen dioxide or nitrogen

TABLE III.
Process Figures (monthly averages).

Bomb.	HNO ₃ in g. per cb. m. in exit-gas at 20° C.	NO-content of exit-gas. Per cent. by vol.	Ratio coke-oven gas : exit-gas.	HNO ₃ -yield per cb. m. of coke-oven gas (4000 heat units).	Actual yield per cb. m. of coke-oven gas.	
					HNO ₃	NaNO ₂
100-litre	12	0.45	1 : 5.6	67 g.	37-46 g.	6-8 g.
300-litre	16-18.5	0.6-0.7	1 : 6.0-1 : 5.8	96-107 g.	52-54 g.	5-7 g.

A calculation of the reaction velocity [cf. equation (2)] under pressure based on Bodenstein's researches¹ is given in the appendix. This shows that the cubic contents of a gas-absorption plant at 3 atm. excess pressure are about 1.5 per cent. of those required for gas at normal pressure. Such a pressure is easily maintained technically by means of the bombs. No other nitrogen fixation process offers such facilities for accomplishing the oxidation

tetroxide already formed or by water vapour. Equation (9) is therefore applicable to the nitrous gases leaving the bomb; the assumption that carbon dioxide, which was not present in Bodenstein's experiments, is without influence, is left an open question.

Tablo IV. is calculated for the value $x=0.4c_1$ (i.e., a 40 per cent. oxidation) and for gases containing 0.5, 1.0, and 1.5 per cent., respectively, of nitric oxide and 6.5 per cent. of oxygen; the oxygen, which is in great excess, being taken as constant.

¹ Z. Elektrochem., 1918, 24, 183.

TABLE IV.

40 per cent. Oxidation. Time taken to Nearest Second.

Gas mixture in % by vol.	Pressure. Absolute atmospheres (1 atm. = 760 mm. mercury).			
	1.	2.	3.	4.
O=0.5				
NO=0.5	secs. 91	secs. 23	secs. 10	secs. 6
„=1.0	46	13	5	3
„=1.5	31	8	3	2

A basis is thus obtained for calculating the dimensions of a series of oxidation chambers, it being assumed that oxidation and absorption are conducted alternately in separate operations as in the experimental plant.

Let

Z=vol. of gas passing through the chamber per sec., measured at its pressure and at 30° C.

a_1 =NO-content of gases entering, in vol. per cent.

a_2 =NO-content of exit gases, in vol. per cent.

a =NO-content of gas after the n th stage.

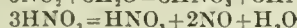
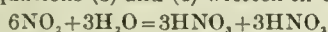
β =degree of oxidation, i.e., proportion of NO oxidised to NO_2 .

$t\beta, a$ =time of oxidation corresponding to NO-content a , in secs.

V_a =corresponding oxidation space.

V =total oxidation space.

From equations (3) and (4) written in the form:



we see that of the six mols. of nitric oxide oxidised, two mols. are regenerated. That is, after the n th stage

$$a = \left(1 - \frac{2}{3}\beta\right)^n a_1$$

$$V_a = Z \cdot t\beta, a.$$

According to Table IV. the oxidation time can be rewritten $t\beta, a = \frac{K}{a}$ in which K is a constant, therefore

$$V_a = \frac{Z \cdot K}{a}, \text{ and the total oxidation space is}$$

$$V = \sum \frac{Z \cdot K}{a}$$

or

$$V = \frac{Z \cdot K}{a_1} \sum_{n=1}^{n=n} \frac{1}{\left(1 - \frac{2}{3}\beta\right)^n} \dots\dots\dots (10)$$

The final loss is

$$a_2 = \left(1 - \frac{2}{3}\beta\right)^n a_1 \dots\dots\dots (11)$$

Example.—Let Z equal 3 cb. m., $a_1 = 1.5$ per cent., $\beta = 0.4$, and let there be 4 stages and the pressure be 4 atm. abs. Then $K = 2.8$, taking the exact value for the oxidation time and not the approximation given in Table IV.

From equation (10):—

$$V = \frac{3 \times 2.8}{1.5} \left(\frac{1}{0.74} + \frac{1}{0.74^2} + \frac{1}{0.74^3} + \frac{1}{0.74^4} \right) \\ = \frac{3 \times 2.8}{1.5} \times 8.97 = 50 \text{ cb. m.}$$

and the final loss, by equation (11), is

$$a_2 = \left(1 - \frac{2}{3} \times 0.4\right)^4 \times 1.5 = 0.45\%$$

With a pressure of 1 abs. atm., $K = 46$, $Z = 12$ cb. m., and, provided that the other quantities be the same as before, $V = 3280$ cb. m.

Equation (10) gives a rather too high figure for the oxidation space, since, to obtain the exact oxidation time, the average values for the stages involved should be substituted; but the difference is not great, and for a low degree of oxidation is negligible.

To the oxidation space, V , must be added an absorption space, which must not be neglected, although the rate of absorption is much greater than that of oxidation. The amount of absorption space cannot be calculated exactly, as it depends upon the efficiency of the means of bringing nitrous gases and water into contact. At ordinary pressure it is probably about 10 per cent. of the oxidation space. So far as the writer knows, the method of calculation here developed for estimating the oxidation space is new. It may also be applied to the usual method of absorption with packed washing-towers alone, in which oxidation and absorption occur in immediate sequence. A correspondingly smaller degree of oxidation must then be included in the calculation.

Summary.

The development of the process of manufacturing nitric acid by means of explosive combustion is described and contrasted with the complicated method of converting elementary nitrogen into nitric acid by the cyanamide method, the synthesis of ammonia under high pressure, and the complex apparatus of the arc process. Starting from a theoretical basis, a description is given of laboratory experiments and the working of a large-scale plant. The further development of the process is foreshadowed, and the simplification of the apparatus required for the absorption of dilute nitrous gases, by the use of pressure, is demonstrated. A method is given for calculating the dimensions of an absorption plant based on Bodenstein's researches on the velocity of formation of nitrogen peroxide.

THE REWARD OF INVENTORS IN GOVERNMENT EMPLOY.

COURTNEY TERRELL.

The Report of the Inter-Departmental Committee appointed to inquire into the reward of inventors in Government employ raises an acute case of the problem of socialising individual effort.

The mutual dependence of all branches of industry in the co-ordination to meet the requirements of a great war has been demonstrated during the last few years, and in 1916 the Department of Scientific and Industrial Research came into being to study scientific and manufacturing problems of all kinds. The researches undertaken have an importance far beyond the obtaining of knowledge immediately applicable to war conditions. The State has now assumed the control of investigations which may in many cases result in inventions of great commercial importance. It has long been the practice on the Continent for commercial organisations to maintain laboratories in which are employed workers who, in exchange for a small salary but reasonable security of tenure, labour in the mere acquirement of knowledge for their employers. If the investigation results in an

invention of commercial value the terms of the employment usually allow of the employee receiving some share of the reward in addition to his salary and security. Nevertheless, in many cases the investigations undertaken can offer no field for the achievement of patentable inventions, and the main attraction to the research worker must not be the hope of large financial reward. Private enterprise directed with imagination has in Germany succeeded in attracting the right men.

The reluctance of the "business man" in this country to spend money on research laboratories drove the Government under the stress of war, to institute such establishments, and now that valuable inventions are resulting we are faced with the problem of how to deal with the inventions when they have been made, and how to reward the research worker who has made them.

Before the war the inventions produced by Government servants were usually of direct military application. Little difficulty arose in dealing with the inventor; the Government was in most cases the only consumer, and if the invention had applications in other fields of industry there was no harm in the inventor receiving the profits of such outside application. Much the same relationship existed between the Government and its employees in this respect, as in the case of the great railway companies and their employees. Now that the Government has extended its sphere far beyond the business of government, now that it undertakes the investigations of problems of industrial manufacture, what is to be done with the inventions which result?

A short-sighted policy might be to publish such information as is obtained by the use of public funds for use by the whole industrial world, and to seek no monopoly protection under the patent laws. But is it possible to attract workers for research into industrial problems without any hope of remuneration beyond a small though secure salary? Socialists answer "yes," but they are faced with the troublesome fact that inventors are not socialists. There is the risk that an investigator might be tempted to communicate his knowledge to someone outside the service who might obtain a patent therefor. And even though (as is doubtless the case) this would seldom occur, there is the further objection that the information when published might be made the subject of patents in foreign countries, so that manufacturers in this country exporting goods would have to pay tribute to the foreign "inventor." This, the writer believes, has actually taken place in one instance at least. This last is not, indeed, an insuperable objection because patents might be applied for in this country and under the International Convention abroad, and the British manufacturers might be licensed free of royalty. Nevertheless it is said that manufacturers will not put down capital unless they are assured of some sort of monopoly as by exclusive licence or ownership of the patent. The comparative failure of the "Licences of Right" provisions of the Act of 1919 would seem to justify this opinion.

The Committee appointed to consider these matters was too large. Three or four members could have dealt with the matter as well as seventeen; with so many every individual desires to express his views on every point, with a consequent waste of time and weariness of those who wish to get to the point. The Report is not well drawn—arguments and conclusions are mixed in exasperating confusion, and many platitudinous truisms are unnecessarily stated.

It is recommended that a central Patents Board should be instituted. One committee of this Board is to take over the work of the Royal Commission, and there is nothing new in the work it has to do. The Treasury will still control the decisions of the committee on "matters of principle" but will not

over-rule the committee's rewards in the mere matter of the sum awarded. Patents are to be assigned to the Department as before. So far there seems to be nothing new in the proposals, which in another form continue the earlier practice.

The really considerable proposal is the establishment of an "Exploitation Committee" of the Patents Board. Paragraph 28 of the Report is as follows:—"The main task of the Exploitation Committee would, however, be to arrange either for the sale of patents or for their use under licence. In order to perform this task satisfactorily, it would be necessary for the committee to employ, as and when required, one or more sales agents paid on commission who would act on general instructions received from the committee in each case, but would have considerable freedom allowed to them in their negotiations with prospective buyers or licensees. We are of opinion that adequate means should be employed to make known amongst British firms the existence of patented inventions made with the aid of public funds, and that such inventions should not be offered to foreign buyers or foreign licensees until every effort has been made to negotiate successfully with British firms or firms under British control. Further, we consider that wherever possible, any foreign patents taken out by the Inter-Departmental Patents Board should be sold outright, since the holding of foreign rights by a Government organisation might lead to serious inconvenience if foreign patents used under licence by foreign firms were infringed or if their validity were attacked and litigation in a foreign country became necessary."

This will mean in practice that the secretary of the committee will do the business, and it is here that one detects the fallacy of the whole proposal. The secretary will be a sort of salaried "business man" who will have the inestimable advantage that he cannot be "sacked" if the business is badly done. He will have to deal with business firms and be open to all the temptations of the man who has the power to grant concessions. The committee with its "panel of business men" (cf. paragraph 12) will sink into insignificance even though they do their utmost to keep control. In times of peace the "business man" will not attend board meetings for which he is not paid and in whose deliberations he has no direct interest.

The proposal is one step further in the direction of commercial enterprise by Government Departments, and ought to be condemned. The mistake lies in the notion that the patents obtained by the work of Government research workers should be dealt with in the interest of the commercial investor. In the writer's opinion it would be better statesmanship to endorse all such patents "licences of right," and to let the Awards Committee give a definite proportion of the sum derived from royalties to the inventor. The inventor might be allowed to make any efforts he chose to induce manufacturers to take up the invention. The publication of the information would sooner or later result in applications for licences, even at a comparatively small royalty, and patents granted might be exempted from the payment of fees.

The scheme recommended by the Committee is dangerous. Financial groups enjoy enough power as it is, and the existence of a body with power to grant valuable concessions will inevitably lead to well-known evils if efficient, and if inefficient to a useless waste of money and to the disappointment of the inventor. The investigator appointed to inquire into industrial difficulties should have enough knowledge to enable him to open negotiations, and if the terms demanded are excessive the existing machinery by which the Comptroller could fix the terms is quite adequate to protect the inventor as well as the Department and the manufacturer.

SOCIETY OF CHEMICAL INDUSTRY.

CANADA.

The annual meeting of the Canadian Sections of the Society of Chemical Industry was held at Ottawa from May 15 to 17, and, as has been the custom during the past four years, a general meeting of Canadian chemists was convened at the same time. About 120 chemists were in attendance.

On May 15 the Associate Committee of Chemists of the Advisory Research Council held two sessions at which papers dealing with chemical problems were presented and discussed.

In the evening a meeting of representatives from all the Canadian Sections was held and a Council was formed. Mr. Alfred Burton was elected hon. secretary for the ensuing year. In the future this Council will consist of the chairman and ex-chairman of each Section.

The annual general meeting of the Canadian Sections was held in the Chateau Laurier on May 16, Mr. F. J. Hambly, chairman of the Ottawa Section, presiding, and Mr. A. E. Macrae acting as secretary. The chairman welcomed the members and expressed appreciation of the large attendance at the meeting.

Prof. R. F. Ruttan expressed his thanks to the Canadian Sections for having nominated him to the presidency of the Society. He referred to the eminence of his predecessors in the chair and to the great honour which the parent society had conferred upon Canada in selecting a Canadian as president. In so doing, he said, the Society had recognised the development of chemistry in Canada, and had sown the seeds of future co-operation among the chemists of both countries. Thanks were due to the Canadian Sections for their hospitality to the visitors on the occasion of last year's annual meeting, and he felt that the result had been very successful and appreciated by the British and American guests. That visit had undoubtedly had a stimulating and strengthening effect upon the chemists of Canada, and there had been a distinct awakening on the part of manufacturers and others to the importance of chemistry in national life.

Dr. Ruttan then dealt at considerable length with the organisation and work of the British Department of Scientific and Industrial Research, and with the objects and aspirations of the Canadian Research Council. He advocated the establishment of research guilds with simply-equipped laboratories, each of which might cost about \$25,000, and salaries adequate to attract back to Canada some of the brilliant men who had left the country. The guilds, he explained, would be formed from groups of industries interested in the same line of research, and the industries would to some extent pool the expense; but State aid was also required. He believed there would soon be a revival and extension of chemical industry in Canada. There was an abundance of raw material and water power, and he had sufficient faith in the ability, energy and resourcefulness of his countrymen to believe that they would be developed and utilised.

Mr. Davies, Toronto, invited the Canadian Sections to hold their next annual meeting in Toronto, and the invitation was accepted.

Mr. C. E. Wallin, superintendent of the coke-oven plant of the British Empire Steel Corporation, read a paper upon the "Operation of Koppers By-product Oven Plant." He gave a description of the method of coking and recovering by-products from Cape Breton coals, and emphasised the differences in composition and yield of products obtained by the Koppers and Otto plants upon the same coals.

Mr. F. E. Lathe, chief chemist to the British

America Nickel Corporation, Doschenes, Que., presented a very interesting paper upon "Analytical Problems in the Metallurgy of Nickel." He described the various methods employed for the estimation of copper, iron, sulphur, nickel, cobalt, silicon, etc. in nickel ores, matte and metallic nickel, and also the determination of constituents of the electrolyte employed in refining. The rapid and the accurate works' methods were then given in greater detail. The paper was discussed by Messrs. Ardagh, Burt-Geerans and Connor.

Dr. J. W. Shipley, University of Manitoba, read a paper of very great importance to the people of Manitoba, Saskatchewan, and Alberta on "Self-Corrosion of Cast Iron and Lead Pipes in Alkaline Soils." The soils in the Winnipeg district were described as limey clay silts heavily impregnated with crystals of selenite or gypsum, together with magnesium sulphate. The average electrical resistance of 18 samples was 570 ohms per c.c. Graphitic softening of the cast-iron water-mains and pock-marked corrosion of lead service pipes were found to occur, and this was complicated by the possible stray current-leakage from the tramway system. Investigation showed that graphitic softening occurred in salt solutions and in iron buried in soils in the laboratory. Experiments with concentration cells indicated that local galvanic action set up either by differences in concentration of the salts in contact with the pipe or differences in composition of the pipe material, accounted for the corrosive action. Corrosion of lead pipes was produced in the laboratory by leaving the lead in contact with the soil for a few months. Corrosion of both iron and lead was frequently found to be most marked where the metal was in contact with a pebble or with the glass of the container. Dr. Shipley exhibited a number of specimens of the soils and corroded iron and lead pipes. This paper was discussed by Messrs. Job, Neish, Macintyre, Connor and Mackie.

"Chemical Products from Natural Gas" was the subject of a paper presented by Mr. R. T. Elworthy, of the Mines Branch, Department of Mines, Ottawa. The average composition of various natural gases of Canada was given, together with their present general application. It was pointed out that many of the wells were remote from inhabited and industrial centres, and that much gas was going to waste. After reference to the recovery of casing-head gasoline and the manufacture of carbon black from the gases, the attempts of many chemists to convert the gaseous constituents into valuable chemical products were considered. Mr. Elworthy then described a series of experiments which he had carried out, endeavouring, by means of the action of oxygen and other gases at different temperatures and pressures and with a variety of catalysts, to produce commercial chemical products from natural gas. The results, so far, were not promising or economic, but the investigations are being continued.

Mr. J. A. Dawson, Dominion Department of Health Laboratory, Vancouver, B.C., read a paper upon "The Composition and Properties of Loganberry Juice." After speaking of the geographical distribution and general character of the loganberry, the popularity of its juice as a beverage, and the industrial horticultural development in the Pacific States and British Columbia, the author described in detail the methods employed and results obtained in his investigation upon the expressed juice of the berry. He found that in the determination of the total solids by various recognised methods the most accurate results were obtained by the specific gravity method. The investigation clearly demonstrated that the free acid content (calculated as citric acid) was greatest in

the north (British Columbia), and decreased progressively towards the south (California). The percentage of ash, on the other hand, was greatest in Californian juice and lowest in that of British Columbia. This was probably due to climatic conditions. The investigation is being continued, and having been carried out for a Government department, it will probably be published as a bulletin, which will contain the legal standards required for the fruit juice and for preparations made from it.

The annual session of the Society closed with a dinner and a "smoker" at the clubhouse of the Rivermead Golf Club, Deschenes, Que. Dr. H. van der Linde, Toronto, acted as chairman, and a very enjoyable evening was spent.

Various meetings and functions were held in connexion with the Canadian Institute of Chemistry. The business meeting was held on May 17, with the retiring president, Prof. Watson Bain, in the chair.

The following officers were elected for the ensuing year:—President: Dr. J. S. Bates, Bathurst, N.B.; Vice-Presidents: F. J. Hambly, Buckingham, Que.; M. A. Parker, Winnipeg, Man.; E. G. R. Ardagh, Toronto; hon. secretary: L. E. Westman, Toronto; hon. treasurer: Prof. E. Ardagh, Toronto, Ont.

The annual dinner of the Institute was held in the Chateau Laurier in the evening. Among those in attendance were the Hon. Jacques Bureau, Minister of Customs and Excise; Mr. J. H. Harris, M.P.; and Mr. W. C. Good, M.P.

SHAWINIGAN FALLS SECTION.

The annual meeting was held after the annual dinner on May 26, Dr. F. W. Skirrow presiding. The reports of the hon. secretary and hon. treasurer were read and accepted. According to the former the Section has suffered a slight decrease in membership as a result of the industrial depression, but it is still sufficiently strong to maintain a vigorous life, and no further falling off is anticipated. The urgent need is for more *working* members, i.e., members who will read papers, give addresses, attend meetings and take part in discussions. During the past session more papers and addresses were given by visitors than by resident members. An arrangement has been made with the local section of the Canadian Electrical Association whereby members of either body are notified of and granted the privilege of attending the meetings of the other; also, the two organisations will work together on matters of common interest.

The following Sectional officers were elected for the session 1922-23:—Chairman: Mr. R. A. Witherspoon (general manager of the Canada Carbide Co., Ltd.); hon. secretary: Mr. F. E. Dickie; hon. treasurer: Mr. E. R. Williams. Owing to the resignation of Mr. G. Meerbergen, who has gone to Belgium, Mr. A. H. Maude was elected to fill his place on the committee of the Section. Notice was given of two proposed changes in the draft Rules and the meeting was adjourned.

OTTAWA SECTION.

This Section held its annual meeting in the University Club, Ottawa, on May 5, with Mr. F. J. Hambly in the chair. The principal business was the discussion of the draft Sectional Rules, drawn up by a committee appointed *ad hoc*; these were approved and adopted as read.

In presenting the report of the committee appointed to nominate officers and members of the sectional committee, Colonel Janson announced that Mr. S. J. Cook wished to retire from the office of hon. secretary owing to pressure of work. The following were then elected:—Chairman: Mr. F. J. Hambly; hon. secretary: Mr. A. E. MacRae;

Committee: Dr. A. Tingle, Messrs. J. Dick, R. T. Elworthy, W. B. Kitto, and F. E. Lathe. The chairman then thanked Mr. Cook in the name of the Section for his excellent work as hon. secretary during the past four years. A vote of thanks was passed to him, and in reply Mr. Cook reviewed the development of the Ottawa Section since its inception, and stated that his position had been a continuous source of pleasure to him, and that his thanks were due to the members of the committee who had greatly lightened his work on behalf of the Society.

MEETINGS OF OTHER SOCIETIES.

THE CHEMICAL SOCIETY.

On June 8, at the Institution of Mechanical Engineers, Dr. H. H. Dale delivered a lecture on "Chemical and Physiological Properties."

The ultimate object of all pharmacological investigation is the interpretation of the physiological effects which many chemical substances produce. At bottom, the problem is a chemical one, and the chemist by modifying the structure of a substance of known activity by the introduction of various radicles has produced a great number of new compounds whose physiological action has been recorded. The results strike one as the scattered fragments of a vast jigsaw puzzle. It is the general plan of the picture into which these will fit which interests the pharmacologist. The problem is extraordinarily difficult, but a correct conception of the relation of the active chemical compound to the physiological mechanism whose activity it modifies might furnish an important clue to the nature of the normal physiological process.

The physical properties of the indifferent anaesthetics, alcohols, chloroform, ethers, urethanes, show a roughly parallel variation with their narcotic properties. The present tendency is to interpret the latter properties in terms of surface activity whereby these narcotics alter the permeability of cell membranes through adsorption on their surfaces.

The most fascinating problem, however, is the action of certain bases of extreme intensity of action and specificity of localisation; adrenaline, atropine, muscarine, choline esters and arecoline fall into groups which reproduce the effects of stimulation either of the sympathetic or parasympathetic nervous system. There must be some receptive structure which is neither muscle nor nerve which has a specific affinity for one or another group of active bases. But why one group should inhibit and another augment, although similarly localised, is unknown. Pilocarpine, arecoline, choline are similarly localised, but there is no obvious relation between their chemical structures.

On the other hand, in the group of sympathomimetic amines studied by Barger and Dale, in the relation of enzymes to sugars and glucosides, and in Hamburger's recent work on the permeability of the membranes of the frog's kidney to α -sugars and impermeability to β -sugars, the specific adaptation of vital structures to molecular shape is a salient feature. Throughout, the problem is probably one of residual valencies, for there are all gradations of specificity from the adsorption of indifferent anaesthetics on protoplasmic surfaces to the uncanny precision with which some alkaloids are localised on certain cell structures.

The last ordinary scientific meeting of the session was held on June 15, Sir James Walker presiding.

The following two papers were read:—"Ring-chain tautomerism. Part III. The occurrence of tautomerism of the three-carbon (glutaconic) type between a homocyclic compound and its unsaturated open-chain isomeride": C. K. Ingold and E. A. Perren; and "The tautomerism of dyads. Part I. Experiments on the detection of tautomeric equilibria in hydrocyanic acid": E. H. Usherwood.

The paper read by Dr. Ingold continued the considerations of the reversibility of the Michael reaction applied to tautomerism in glutaconic esters. The paper was discussed by Prof. Alfred Noyes, a visitor to the Society, Dr. R. H. Pickard and Dr. N. V. Sidgwick. Miss Usherwood has correlated heat of chemical change, alteration of the equilibrium constant and the ratio of the specific heats at various temperatures, and has applied the results to the study of the occurrence of hydrocyanic acid in its *iso*-form.

INSTITUTION OF GAS ENGINEERS.

The annual general meeting was held in London on June 20-22 under the presidency of Mr. T. Hardie. The Research Sub-Committee of the Institution submitted its seventh report dealing with the efficiency of production of carburetted water gas of calorific value about 485 B.Th.U. gross per cb. ft. Neglecting steam raised or required in the process, the efficiency of blue water-gas production was found to be about 53 per cent. By employing waste-heat boilers, this efficiency was raised to 59.5 per cent. Oil-gas production afforded an efficiency of 90 per cent., and the resultant efficiency of carburetted water-gas production was 68 per cent.

Dr. A. C. Monkhouse and Prof. J. W. Cobb submitted a paper on "The Liberation of Nitrogen and Sulphur from Coal and Coke." The authors have investigated cokes produced from coal carbonised at 500° C., 800° C., and 1100° C., respectively, and determined the evolution of ammonia and hydrogen sulphide as conditioned by the presence of nitrogen, hydrogen or steam. By gasification of coke with steam the whole of the nitrogen of the coke was evolved as ammonia, the liberation of ammonia being much more rapid at about 600° C. than with hydrogen. Liberation of ammonia by steam from hard coke was much slower than from soft coke and very much slower at 800° C. than at 900° C. On heating the cokes in nitrogen, very little sulphuretted hydrogen was evolved up to 1000° C. By heating the 500° C. coke in hydrogen up to 1000° C., 93.8 per cent. of its sulphur content was liberated as hydrogen sulphide. On heating the coke in steam, hydrogen-sulphide liberation up to 800° C. was probably the same as in hydrogen, but completion of decomposition could not be secured in steam at that temperature.

The report of the Life of Gas Meters Committee dealt *inter alia* with a process for extracting hydrogen cyanide from coal gas in which chalk is employed in a continuous cycle of operations for the conversion of the acid into ammonium thiocyanate.

Mr. A. E. Broadberry presented the report of the Refractory Materials Research Committee embodying a paper on "The Standardisation of the After-Contraction Test" by Miss D. A. Jones, and one on "The Thermal Conductivity of Refractories at High Temperatures" by Mr. A. T. Green. The latter paper describes a method for determining the thermal conductivity of a refractory material by observing, during the initial stages of heating, the rate of rise of temperature at any isothermal plane in the refractory at a known distance from a face maintained throughout at a definite temperature. Except in the case of magnesite, the values obtained for the thermal conductivities of various samples agree with the values found by Heyn,

Bauer and Wetzel, but are much lower than those derived by other observers using calorimetric methods based upon observations made during the steady state of flow of heat.

In a paper on "Some Gas Burners and a Moral," Dr. Charles Carpenter traced briefly the evolution of the modern gas-burner employed for lighting purposes, and insisted on the necessity for providing gas consumers with standardised fittings, burners, mantles, etc.

Dr. G. Weyman submitted a paper on "Increasing the Rate of Carbonisation of Coal," in which he shows that considerable increase in the rate of carbonisation of coal may be obtained by selecting coals from which gas is evolved above a minimum rate. Except for oxidised coals, the calorific value and thermal yield are higher for an increased rate. A higher carbonising temperature is accompanied by an increase in gas volume and thermal yield.

Prof. C. V. Boys described and exhibited his "Recording and Integrating Gas Calorimeter." The calorimeter has been designed to meet the requirements of gas testing imposed by the Gas Regulation Act of 1920. It is of the water-flow type and embodies many novel features. Both water and gas are doled out positively at the correct rate and the correction of gas volume to standard temperature, pressure and humidity is effected by positive operation. This correction is effected by what Prof. Boys terms a "thinking machine," consisting of a half-disc-cylinder integrator, controlling the rate of revolution of the drum of the gas-meter, which itself is of a novel type. An integrating device exhibits a figure indicating the average departure of the recorded calorific value from the declared calorific value since the record was last set to zero.

NEWS AND NOTES.

FRANCE.

International Congress on Liquid Fuels.—We are informed that the Société de Chimie Industrielle, assisted by a large and representative committee, is organising a congress on liquid fuels to be held in Paris in October under the presidency of Prof. P. Sabatier and the patronage of the French Ministers of Commerce, Public Works, Agriculture, and the Colonies. The two chief items on the agenda will be the terminology of petroleum products, and tests and analyses. It is proposed that every nation shall be free to retain its own system of nomenclature and methods of analysis, but that in every case the exact connotation of the terms employed shall be clearly defined. The aim of the Society in organising this meeting is solely to bring together representatives of the various nations, and it is hoped that some members of the Society of Chemical Industry will find it convenient to attend. The subject will be divided into the following six sections: oil-shales, lignite and peat, tar and benzol, alcohols, and vegetable oils; and there will also be an exhibition of petroleum products and appliances. Suggestions concerning the proposed agenda of the congress, etc. will be welcomed by the Société.

Proposed Use of Basalt in Chemical Industry.—The extreme hardness of basalt has limited its use to building and road-making, but the researches of Dr. Ribe have shown that it can be melted and cast at about 1300° C. without losing its natural properties, and therefore it will probably find extensive use in chemical industry. Dr. Ribe's process has been perfected by the Compagnie Générale du Basalte (*cf.* J., 1922, 15A), which, it is stated, will soon be able to produce a coarse basalt for

paving and a finer product for chemical and electrical use. As an electrical insulator, basalt resembles glass and porcelain, but it has the advantage of not being disintegrated by the electric arc; it resolidifies when the current ceases to pass. Further, articles made of it are practically unbreakable, and iron bars can be incorporated in melted basalt without having to be sealed in subsequently with cement. Laboratory and works tests have shown that basalt is highly resistant to corrosion, even by hot acids.—(*Chim. et Ind.*, Apr., 1922.)

"Soddite," a New Radioactive Mineral.—At a recent meeting of the French Académie des Sciences, M. A. Schoep described a new radioactive mineral which he proposes to name "Soddite," in honour of Prof. F. Soddy. The mineral is intimately associated with the curite of Kasolo (Katanga) in the Belgian Congo, and consists of small, dull yellow, rhombic crystals possessing a hardness varying between 3 and 4 and a density (determined on pure specimens) of 4.627 at 17° C. Its percentage composition was found to be (average): SiO₂ 7.83; UO₂ 85.33; H₂O 6.23, corresponding to the formula 12UO₂·5SiO₂·14H₂O. The radioactivity of the mineral is in proportion to its high content of uranium.—(*Compt. rend.*, 174, No. 16, 1922.)

JAPAN.

New Tinplate Industry.—It is reported that the first tinplate factory in Japan, established in connexion with the Government ironworks, has been working continuously since the end of January last. The tinplate is not yet on the market, but is said to compare favourably with the foreign product.—(*Ch. of Comm. J.*, May 19, 1922.)

Consumption of Fertilisers.—Agriculture is still the chief industry in Japan and large quantities of fertilisers are required to maintain the intensive cultivation of crops necessary to feed the increasing population. Fish manure, bean and oil cakes, bone meal, superphosphates and ammonium sulphate are all made in the country, and in 1919 the production included 339,000 long tons of bean cake, 12,450 t. of ammonium sulphate, and 95,000 t. of phosphates, the total production of fertilisers being 1,720,000 t. Imports in 1919 amounted to 1,495,000 t. and included:—Bean cake 1,331,000 t.; sodium nitrate 64,490 t.; ammonium sulphate 100,000 t. In 1920 imports declined to 1,065,000 t., including:—Sodium nitrate 121,600 t., bone manure 49,950 t., ammonium sulphate 71,000 t., phosphate rock 281,200 t. All the sodium nitrate is imported, and the imports of ammonium sulphate come chiefly from the United States (50 per cent. in 1920) and Great Britain. Raza Island can produce 200,000 t. per annum of phosphate rock, but the whole output cannot be shipped to Japan. Although the output of Rosa phosphate is now likely to decline, Japan possesses other sources in the mandated Pelew and Marshall Islands and in the newly-discovered island of Hirata, south of Hainan. It is reported that the Raza Island Phosphate Co. is attempting to monopolise phosphate rock in Japan. Figures of imports in 1921 are not available, but the general tendency is stated to be upwards.—(*U.S. Com. Rep.*, Apr. 10, 1922.)

AUSTRALIA.

Projected Fertiliser Industry in Tasmania.—The manufacture of superphosphate and high-grade fertilisers will probably be initiated before long in Tasmania at the Risdon factory of the Electrolytic Zinc Co. An output of 5000 to 10,000 tons is anticipated during the first year, and Nauru phosphate is to be utilised as raw material. The annual importation of fertilisers into Tasmania is about 13,000 t. (*cf. J.*, 1921, 311 R.).—(*Ind. Austr.*, Apr. 6, 1922.)

Lead Smelting in New South Wales.—Owing to the decision of the Sulphide Corporation to close its lead-smelting plant and refinery at Cockle Creek, on account of shortage of ore and prohibitive operating costs, the lead ores produced by the Corporation will in future be smelted by the Broken Hill Associated Smelter Co. at Port Pirie. The manufacture of sulphuric acid and of fertilisers will, however, be continued at Cockle Creek.—(*Ind. Austr.*, Mar. 30, 1922.)

Closure of the Commonwealth Acetate-of-Lime Factory.—The Royal Automobile Club of Queensland has entered a strong protest against the closure by the Commonwealth Government of the acetate-of-lime factory on the Brisbane River. The factory was erected during the war in connexion with the manufacture of cordite, and is the only one of its kind in the country. It is now being used to produce power alcohol, and it is felt that every effort should be made to render Australia independent of overseas supplies of liquid fuel.—(*Ind. Austr.*, Apr. 20, 1922.)

SOUTH AFRICA.

Sugar Production in Natal.—According to the *South African Sugar Journal*, 155,500 tons of sugar was manufactured in Natal during the past season. Assuming that 4000 t. will be lost in refining, the net return should be about 151,000 t. Including 12,000 t., sent through the Transvaal from Mozambique, the total entry into the Union was 163,500 t., and as roughly 32,000 t. was exported, 131,500 t. remained for consumption in the Union.

CANADA.

Industrial Notes.—Thomas Draper, Petrolia, Ont., has leased 1920 acres of tar-sand property in Alberta from the Federal Government.

The production of honey last year in the Province of Quebec was 3,800,000 lb. (nearly 1700 long tons), compared with 2,600,000 lb. in 1920.

It is planned to start a shark-skin tannery on the west coast of Vancouver Island, B.C. Sharks are plentiful off the west coast. Oils and other products will also be recovered from the fish.

The Electroplax Co., Ltd., Toronto, has been formed for the purpose of manufacturing phenol-condensation products of the Cutler-Hammer Co., Milwaukee. It is understood that "Redmanol" products will be manufactured.

The Oliver Chemical Co. has decided to erect a chemical factory at Penticton, B.C., for the manufacture of insecticides and spraying compounds. The Premier Oliver Co. of British Columbia has a large interest in the new company.

The Corning Glass Works, Corning, N.Y., the well-known manufacturers of "Pyrex" chemical and household glassware, is to erect a factory in Canada. It is understood that the plant will be in operation before the close of the year.

The formation of the Hochelaga Cement Co., Ltd., Montreal, has been announced. The company will erect works near Montreal with an ultimate capacity of 5000 barrels of cement a day, but initially only 2500 barrels will be produced.

The American Cyanamid Co. at Niagara Falls, Ont., is preparing for better times, and the cyanamide department has been speeded up for the first time since the slump in the autumn of 1920. Two furnaces now being operated. Another carbide furnace will start at an early date.

The fishery by-products plant at Tuck's Inlet, near Prince Rupert, B.C., which has been idle for over two years, has started operations again. It utilises the offal from the salmon and halibut fisheries of the district, making fish oil, fish fertiliser and edible fish-meal. The factory will operate all the year, and this season expects to export 100,000 barrels of fish oil.

The president of the National Electric Products, Ltd., has announced the amalgamation of that company with the Dominion Oxygen Co., Ltd. The enlarged company is organising a complete chain of branches through all the important centres of Canada. At present there are plants in Montreal, Toronto, Hamilton, Merrittton, Quebec, Shawinigan Falls, Welland, Windsor, and Winnipeg. The Dominion Oxygen Co. is affiliated with the National Carbon Co. and the Prest-O-Lite Co. of Canada, the largest corporations of their kind in North America. The amalgamation is being effected on the basis of an exchange of securities and no issue of capital is contemplated.

Mining Notes.—A new strike of silver is reported in Erickson Gulch, Yukon Territory. The veins run from 3 to 6 ft., and average assays give 500 ounces to the ton.

Rich gold ore has been struck in the Sylvanite mine of Kirkland Lake district at a depth of 390 feet. The width of the strike is from 7 to 9 ft.

It is proposed to investigate the quicksilver mine on Hardy Mountain, B.C., at an early date, with a view to recovering the metal by the new electric distillation process.

The Mining Corporation of Canada has spent about \$400,000 in drilling, sinking and cross-cutting upon the Flin Flon property, in North-Western Manitoba. It is claimed to have verified the presence of 16 million tons of assured ore, with a possible and probable quantity of 30 million tons. In the 16 million tons of assured ore, the approximate value of the gold would be \$26,000,000, the silver \$13,000,000, and the copper \$11,000,000.

Petroleum.—The Royal Canadian Syndicate, composed of New York men, has entered into a contract with the Dominion Government to drill for oil and gas on the Pakowki Indian reserve, beginning June 1.

A syndicate of well-known Canadian, British and American capitalists is investigating the possible oilfield of the Hay River region, and American prospectors are exploring at Hudson's Hope in the Peace River district.

Alberta is the scene of great activity in drilling for petroleum. The recent discovery of oil in paying quantities at Kevin, in Northern Montana, just across the international boundary from Sweet Grass, Southern Alberta, has stimulated great interest in the latter district and boring will commence at once. The operators are the U.S.A. proprietors of the Kevin oil wells. The Imperial Oil Co. has struck a very heavy flow of wet gas at Faylan, near Winwright, Alberta.

UNITED STATES.

The Potash Plant at Searles Lake.—The American Trona Corporation has reopened its potash plant at Searles Lake, Cal., after a year's closure. The company states that a stock of potash is to be accumulated, as contracts are made by the year, and that the prices will be as low as those of the imported material.

The Chemical Equipment Association was organised by manufacturers of machinery for producing chemicals at a meeting held in the Chemists' Club, New York, on May 10. Among the objects of the Association are: to bring about definite understanding as to professional services rendered to purchasers of equipment; to standardise trade names; and to collect and disseminate information on design, raw materials, and construction.

Allied Dye and Chemical Corporation.—At the annual meeting of this company, the chairman, Dr. W. H. Nichols, announced that the company was now successfully manufacturing ammonia from atmospheric nitrogen on an industrial scale; the

plant was the first of its kind to be operated successfully in the United States and had been working at capacity since it was completed last autumn. Trade depression was responsible for the decrease in the profits of the Corporation during 1921, but the demand for its products had increased and the outlook was promising.—(*Oil, Paint and Drug Rep.*, May 1, 1922.)

The New Duties on Chemicals.—The Senate, sitting to consider the new customs tariff, has decided to increase the *ad valorem* duty on coal-tar products from 30 to 50 per cent., in addition to the basic duty of 7 cents per lb. Sodium and potassium cyanides were placed in the free list, the proposed rate of duty on magnesium chloride was reduced to 0.5 c. per lb. and the rates on magnesite were fixed at from 0.5 to 0.75 c. per lb., and on calcined magnesia at 7 c. per lb. Various new rates were adopted on certain glass products.—(*Oil, Paint and Drug Rep.*, June 5, 1922.)

Organisation of Chinese Chemists.—The Chinese students of chemistry in the University of California and at Stanford University have formed an organisation to bring together the hundred or more Chinese students of chemistry and chemical engineering in the universities of the United States. The object of the organisation, which is to be called "The Chinese Students' Chemical Association," is to encourage Chinese students to take a wider interest in chemistry and to promote a higher appreciation of the place of chemistry in the development of China.

Technical Photographic and Microscopical Society.—This Society has developed from a nucleus formed at the annual meeting of the American Pulp and Paper Association; it was formally inaugurated at a meeting recently held in the Chemists' Club, New York. Mr. J. McDowell was elected president and Mr. T. J. Keenan (editor of the journal *Paper*) secretary-treasurer, and the membership fee was fixed at \$5 per annum. It is intended to hold a general convention of industrial photographers and photo-micrographers in connexion with the National Exposition of Chemical Industries to be held from September 11 to 16. Particulars can be obtained from the secretary, at 251, West Nineteenth Street, New York.—(*Oil, Paint and Drug Rep.*, May 15, 1922.)

Proposed Change in the Patent Law.—Reinforcement of the Patent Law is being urged by the American Chemical Society to prevent any patentee, whether domestic or alien, from using his patent to suppress or limit industrial development in the United States. The Society's Committee on National Policy, which was asked to consider what legislation was necessary to attain this object, passed a resolution affirming that the use of patent rights to limit industrial development was contrary to the purpose of the patent law, and that the Society was in favour of the principle of the Stanley Bill, as amended. As now worded the Bill applies only to U.S. patents that are also taken out in foreign countries (less than 10 per cent. of the total number) and protects the patentee during the development period by allowing him to "prove reasonable diligence in bringing about a *bona fide* working of the patent." The amendment to the Bill, however, provides that if a U.S. patent is worked abroad but not at home within two years after issue, and if the patentee refuses to allow it to be worked under licence on reasonable terms, the U.S. Court of Appeals may, on application, issue a non-exclusive licence. This amendment is claimed by the American Chemical Society to offer a solution of the problem of preventing those who manufacture abroad from taking out patents in the United States solely to make competition impossible from goods made in the United States.

The Patent Convention with Germany has been revived on the understanding that, if the Stanley Bill now before Congress is enacted, the convention can be denounced and subsequently modified.

GENERAL.

Exports of Sugar from the British West Indies in 1921.—The total exports of sugar from the British West Indies in 1921 amounted to roughly 260,327 tons, a large increase over 1920, but a decline of about 40,000 t., compared with 1916-17. Including the estimated figure for Jamaica, the exports from the West Indies in 1921 were as follows:—

		Crystals.	Muscovado.	Molasses.	Syrup.
Jamaica	Tons	43,500	—	—	—
Trinidad	"	46,149	—	60,729	—
British Guiana	"	103,270	—	2	—
Barbados	"	23,945	2,400	5,207	36,707
Antigua	"	8,400	965	1,301	—
St. Kitts	"	7,885	249	423	7,670
Montserrat	"	—	30	—	—
St. Lucia	"	2,972	266	28	1,000
St. Vincent	"	—	167	965	—
Totals	"	241,121	4,077	68,655	45,386

It is estimated that this season's sugar crop in the British West Indies will be approximately equal to that of the past season.—(*Comm. Int. J., Can., Mar. 25, 1922.*)

Graphite in Kenya Colony.—According to *The Farmers' Journal*, there is an enormous deposit of graphite close to the surface of Tulimani Hill in the Machakos district of Kenya Colony. The greatest width of the ore body is stated to be 110 ft. and the present working face 75 ft. across; the ore is being quarried, but bores have been put down 75 ft. without reaching the bottom. It is intended to erect refining plant and to manufacture graphite products at Nairobi. Refractory bricks have been made locally from the ore, and as cedar wood is abundant in the vicinity, it has been suggested that pencils might be made at the Nairobi factory.—(*Bull. Imp. Inst., XIX, 4, 1921.*)

Radium Production in Turkestan.—According to information published in official Soviet newspapers, a deposit of radium ore in the Ferghana valley is being developed by the Soviet Mining Council. It is further stated that the ore is transported to the Bondujee chemical works, where it is extracted in a plant recently erected for the purpose.—(*U.S. Com. Rep., May 8, 1922.*)

Mineral Exports of Brazil.—Official statistics give the exports of minerals in 1919 and 1920 as follows:—

		1919.	1920.
Agate	metric tons	0.41	32.06
Coal	"	4379.45	2.46
Copper ore	"	—	105.0
Crystal	"	27.12	39.63
Graphite	"	2.16	—
Iron ore	"	100.0	17.1
Pig Iron	"	10.0	85.42
Manganese ore	"	205,725	453,737
Mica	"	154.35	68.13
Monazite	"	146.18	1,153.08
Zirconium sand	"	207.61	541.51
Black diamonds	\$	605,957	633,926
Diamonds	"	1,365,372	1,083,528
Precious stones, other	"	109,343	110,148

—(*U.S. Com. Rep., Feb. 6, 1922.*)

Projected New Nitrogen-Fixation Works in Austria.—The Salzburg district authorities and the Stickstoff A.-G., in which much German, and especially Bavarian, capital is invested, have come to an agreement for extending the power-station at Fusch and for erecting in connexion with it a nitrogen factory at Golling in Austria. Work on the power-station will be commenced at once, as the company has guaranteed a sum of 1.3 milliard kronen (krone=10d. at par, now about 0.08d.) to defray the cost of increasing the capacity of the station to 100,000 h.p.

The new factory at Golling is to be erected by a new German company, the Cosag, Kontinentale Stickstoff-Werke A.-G., which commands a capital of 40.95 million marks.

Patent Fees in Austria.—From February 15 last the fees for Austrian patents were increased about ten-fold, viz., application 5000 kronen; first year 5000 kr.; second year 6000 kr., and so on, up to 60,000 kr. for the fifteenth year. The fees for official copies and those charged by the patent-agents have also been changed.—(*Chem.-Z., Apr. 25, 1922.*)

Mining in Austria.—The Mitterberger Kupfer A.-G., in Mühlbach, near Eischshofen (Salzburg), which is controlled by the firm of Krupp, is increasing its production of copper ore as a result of which it is thought that the Austrian production, already derived chiefly from the Mitterberg mines, will become sufficient for the country's requirements. It is, in fact, possible that Austria may export the metal in future; there are already stocks of ore at the Mitterberg mines valued at four milliard kronen. Explorations near Reichenau and Kernkirchheim, in Corinthia, have revealed the presence of iron ore carrying up to 70 per cent. of iron, and also deposits of magnesite, mercury ore, and graphite. An English-American group is interested in the exploitation of these deposits.—(*Mettall u. Erz, Mar. 8, 1922.*)

Zinc Production in Belgium in 1921.—The Belgian output of crude zinc declined from 84,260 metric tons in 1920 to 66,470 t. in 1921, the average monthly production falling from 7021 t. to 5540 t. Whereas 8310 t. was produced in January, 1921, the output fell to 4321 t. in April, but improved in August, and as new furnaces were lit during the autumn, production in December reached 7370 t. Figures of consumption for 1921 have not yet been published. In 1920, 12 zinc foundries and 9 zinc rolling-mills employed 5815 men, and the production of rolled zinc was 57,130 t.. In the same year the 4 lead and silver works produced 16,040 t. of lead and 14,760 kg. of silver from imported ore (20,290 t.), Belgian ore (1560 t.), and from by-products containing lead and silver (29,210 t.).—(*Mettall u. Erz, Apr. 8, 1922.*)

Suggested Use in Sweden of Peat Briquettes Impregnated with Shale Oil.—The Swedish Board of Commerce has received a suggestion that shale oil could be utilised to impregnate peat briquettes by a very simple process, viz., by mixing the powdered peat with 10 per cent. by weight of shale oil and then briquetting. The price of such briquettes is stated to be one-half that of anthracite. (*Cf. J., 1921, 151 n.*)

Industrial Development in Portuguese East Africa.—During recent years industry in Portuguese East Africa has developed considerably, and not only have existing undertakings been extended, but new industries have been established. Most of the sugar factories have been, or are to be, enlarged, and land is being taken up for the cultivation of oil-seeds and other crops, and the coconut and sisal plantations in the north are being extended and equipped with machinery. A British company has established a factory for the manufacture of pulp from baobab trees in the Tete district, and a soap and oil factory, erected in 1917 by a company in which British capital is invested, is producing 40,000 cases of soap and 2000 t. of oil per annum.

The ancient gold and copper mines of the Companhia do Moçambique in Manicaland are the only mines now actively worked, but prospecting for various minerals has been carried on. Petroleum is reported to have been discovered in the Zambezi region, tin and other minerals in other districts, and coal has been located near Tete. A cement factory has recently been established at Lourenço Marques to produce 700 t. of high-grade Portland cement a week from limestone and clay, which occur locally in large quantities and are of suitable quality. The factory was designed and equipped by British engineers.—(*S. Afric. Eng., Feb., 1922.*)

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

British Dyestuffs Corporation.

Replying to Mr. Kiley, who had asked whether the Corporation was negotiating with the chief German dyemakers for a working arrangement regarding production, distribution and prices, Mr. Baldwin said that certain preliminary discussions of a non-committal nature had taken place. The views of the Government would depend on the terms of the agreement, if and when one was made. Changes in the directorate or staff of the Corporation were not required to be reported to the Government, but Mr. Vernon Clay had not resigned from the Board.—(June 12.)

In reply to numerous questions, Mr. Baldwin said there had been changes in the technical staff of the Corporation at various times, and he understood that Mr. Vernon Clay had resigned from only one post in the Corporation. An inquiry into the affairs of the Corporation was inadvisable, but if he were dissatisfied with any action taken by it, he would communicate directly with the Government. About one-fifth of the total shares of the Corporation was held by the Government and the Government directors each received £750 per annum as remuneration. No instructions had been given to these directors regarding the principles that must govern any arrangement with the German dye industry, as they were fully aware of the Government's policy. If an agreement were made the terms could be communicated to the House, but the consent of the House would probably not be necessary for ratification. The Advisory Committee appointed under the Dyestuffs Act had made representations concerning the supply of benzol for making dyes, and the maintenance and development of research, but its chief work had been to co-ordinate manufacture in order to prevent unnecessary duplication of effort. He believed that the present board of the Corporation was strenuously endeavouring to establish the dye industry in this country and would, in time, be successful.—(June 19.)

Home-distilled Spirits.

Sir. R. Horne informed Mr. Lindsay that the 36,597,788 proof gallons of spirits distilled during the year ended March 31, 1922, were distributed as follows:—

	Proof gallons.
Retained for home consumption	14,536,226
Exported	5,569,780
Exported as medicinal preparations	137,558
Used in fortifying wines, etc.	269,528
Used in arts and manufactures	403,237
Methylated	5,022,358
Defalcations allowed, etc.	3,792,940
Remaining in bonded warehouses on March 31, 1922	144,210,170

The quantities of imported spirits used for methylation and in arts and manufactures during the year were 982,741 and 65,746 proof galls., respectively.—(June 12.)

Stamp Duties on Registration Certificates for Alkali etc. Works.

In Committee on Ways and Means, Sir J. Baird moved that the stamp duties on certificates of registration for alkali works be increased so as to meet, but not to exceed, the cost of inspection and registration. Last year, revenue from the duties was £4000 and the cost of inspection and collection was £10,000. Rates of duty to vary with the class of works are to be fixed after consultation between the Treasury, the Ministry of Health, and the Secretary for Scotland. The resolution was passed by 97 votes to 42. Subsequently, it was agreed to fix the stamp

duties at double the amounts now charged.—(June 16, 21.)

Coal Output.

Replying to Mr. Hannon, Mr. Bridgeman said that the average output of coal per man-shift of 7 hours during the period January to May, 1922, was nearly 20 cwt., as compared with 19 cwt. per man-shift of 8 hrs. during the five months preceding the report of the Coal Industry Commission and 21 cwt. per man-shift of 8 hrs. during the latter half of 1913.—(June 19.)

Imports of Electric Glow-Lamps and Vulcanised Fibre.

Mr. S. Baldwin, answering Mr. Hancock, gave the number and value of electric glow-lamps, gas filled, imported from Holland in 1920 and 1921, as follows:—1920, 40,392, £5359; 1921, 780,533, £92,387. Imports of vulcanised fibre in 1913, 1920, and 1921 were valued at £24,765, £180,382, and £146,438, respectively; practically the whole import in 1921 was consigned from the United States.—(June 19.)

Sugar Duties.

Clause 6 of the Finance Bill proposing the abolition of the excise duties on sugar and molasses made from home-grown materials was passed in committee by 267 votes to 88, after Mr. Hannon had moved an amendment (negated by 274 votes to 80) to restrict the home industry to the production of sugar polarising not above 97°, in order to protect the sugar-refining industry. Mr. Waterson said that the remission of the duty of 25s. 8d. per cwt. would give the Cantley factory, in which much Dutch capital was invested, a subsidy of £114,000, on the basis of last year's output, but Cuban raw sugar refined in England was selling at 22s. 6d. per cwt. Mr. G. Roberts pointed out that the amendment was put down in the interests of the refiners; that in any case the growth of the industry would be slow, and that the refiners need not fear competition for some years yet. In reply, Sir R. Horne said that the whole agricultural industry of the country had pressed for the abolition of the duty; unless this was done the industry would disappear.—(June 20.)

A motion, introduced by Mr. Holmes, to reduce the customs duties on sugar, was defeated by 227 votes to 79.—(June 21.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Research Apparatus and Chemicals.—The inferiority of apparatus and materials referred to by Sir J. J. Thomson (*cf. J.*, 1922, 242 R) cannot be ascribed to the Act, as importation is not prohibited and the duty is not so high as to deter an investigator from obtaining foreign goods if of appreciably better quality than the domestic products. There is conclusive evidence that Germany is far from maintaining her pre-war standard of quality. The suggestion that research institutions should be allowed licences under the Act cannot be accepted. The increased cost of research cannot be properly assigned, except to a very limited extent, to the operation of the Act in view of the great increase in all costs during recent years, and it is hoped that the stimulus given by the Act to scientific work in industry will more than off-set any disadvantages. No increase can be made in the Exchequer grants to universities and colleges on the ground of increased cost of materials. Research workers should communicate directly with the British makers of fine chemicals, who will, no

doubt, welcome detailed criticism and co-operation in the development of the industry.—(June 12.)

Glass Bottles.—The Treaty of 1837 prevents the imposition of a duty on Dutch goods under Section 2 (1) (b) of the Act, but not under Section 2 (1) (a), to which the complaint regarding glass bottles refers.—(June 12.)

Duty collected under Part I. of the Act during the period October 1, 1921, to May 31, 1922, amounted to £189,835, derived as follows:—France, £28,830; Belgium, £3072; Italy, £4881; Germany, £90,681; United States, £38,177; Japan, £716; other countries, £23,478.—(June 12.)

The French goods on which duty was paid were chiefly optical glass and elements, optical instruments and fine chemicals, and the goods from the United States were principally fine chemicals, scientific and optical instruments, optical glass, wireless valves and vacuum tubes.—(June 20.)

Gas Mantles.—In accordance with the Referee's award, duty at 33½ per cent. is being levied on imported gas mantles in respect of the value of their content of oxides and nitrates of thorium and cerium. Until the value of these ingredients is determined, importers may obtain delivery by depositing a sum equal to the duty on a value of 25 per cent., i.e., 1/83 per cent. of the value of the complete mantles.—(June 15.)

Aluminium and Enamelled Ware.—The Board of Trade is not aware that, since the inquiry, British aluminium and enamelled ware has become much cheaper than the corresponding German articles, but it should be noted that imports of these commodities in April were in excess of the monthly average for the first quarter of 1922.—(June 19.)

Repayment of Duties.—Drawback of duties paid on articles that have afterwards been removed from the lists can only be obtained on re-export if the goods have not been used in this country.—(June 19.)

Small Consignments of articles on which only a small amount of duty is payable, cannot be exempted from duty without legislation, which at present is not contemplated.—(June 20.)

Naphthalene in all forms may be imported free of duty.—(June 20.)

Compound Articles.—Clause 8 of the Finance Bill provides that the Treasury may exempt a dutiable ingredient or part of a compound article from duty if such ingredient is of small value compared with the total value of the article.—(June 20.)

GOVERNMENT ORDERS AND NOTICES.

THE SAFEGUARDING OF INDUSTRIES ACT.—Part I.—The Referee has issued his decision regarding the complaint that boric acid was improperly included in the list of dutiable articles, to the effect that boric acid is not a fine chemical within the Act and therefore it must be removed from the list.

The Board of Trade has received a complaint that "R" sodium hyposulphite has been improperly included in the list of dutiable articles. The complaint is to be submitted to the Referee, and persons directly interested should communicate immediately with the assistant secretary, Board of Trade (Industries and Manufactures Department), Great George Street, London, S.W. 1.

Part II.—The Board of Trade has issued the reports of seven committees appointed under Part II. Of these reports, those on plain and enamelled baths, toys, and gold leaf are unfavourable to the applicants. In accordance with the findings of

these reports, draft Order No. 1 has been laid before the House of Commons for approval. The Order imposes a duty of 33½ per cent. *ad valorem* upon imports from Germany of:—Fabric gloves and glove fabric; unmounted domestic glassware; illuminating glassware for use with artificial light, not including incandescent electric lamp-bulbs, miners' lamp-glasses, and oil-lamp chimneys (glassware which is only pressed, and articles composed of fused silica, vitreosil, or similar material are excluded); domestic hollow-ware of aluminium, and of enamelled steel or wrought iron. If approved, the Order will remain in force until August 19, 1924.

LEGAL INTELLIGENCE.

ALLEGED BREACH OF CONTRACT FOR THE SUPPLY OF CALCIUM CARBIDE.—British Carbide Factories, Ltd., v. The Crown.

In the King's Bench Division, on May 25, Mr. Justice Darling heard a petition of right by the British Carbide Factories, Ltd., against the Crown, arising out of a contract for manufacturing munitions for the Government during the war.

For the suppliant company it was stated that the contract to supply a minimum of 5000 tons of carbide was determined by the Crown after 3000 tons had been delivered. The claim was partly for money which would have been due if the contract had been completed, and partly for damages for its premature determination. There was a counter-claim for the unpaid balance of the sum of £10,000 advanced to the company by the Crown towards the cost of certain new buildings. The agreement was that the loan should be repaid by deducting £1 for every ton of carbide supplied. The Crown claimed repayment of the balance of the advance plus interest, but the company contended that not more than £1 per ton could be recovered up to the time when the last carbide was delivered, because the expenditure had been incurred as much for the benefit of the Crown as for its own benefit. The Crown claimed the right to terminate the agreement, and submitted that, as the suppliant company had been paid a profit of £2 per ton on the difference between 3000 and 5000 tons of carbide, it had received all it was entitled to.

After an adjournment, it was announced on May 29 that the parties had arrived at a settlement on terms endorsed on counsels' briefs.

ALLEGED BREACH OF AGREEMENT FOR THE SUPPLY OF POTASSIUM PERMANGANATE.—British Cyanides Co., Ltd., v. The Crown.

On June 14 Sir F. Newbolt, Official Referee in the High Court, heard a petition of right by the British Cyanides Co., Ltd., for the assessment of damages against the Crown for breach of agreement for the supply of potassium permanganate. The case was heard in October, 1921 (*cf. J.*, 1921, 393 R), by Mr. Justice Darling, who decided that the plaintiff company was entitled to damages for breach of implied promise by the Ministry of Food to give notice that the orders were to be determined, and referred the matter to the Official Referee to fix the amount of damages.

After the hearing had proceeded for some time, the parties agreed to judgment for the plaintiff company for £25,000 and costs, together with a small sum to be fixed later, payment to be completed within a month.

COMPANY NEWS.

BRUNNER, MOND AND CO., LTD.

The annual meeting of this company was held on June 16 in Liverpool. Mr. Roscoe Brunner, chairman of directors, presided and in his speech, after dealing fully with the financial position (*cf. i.*), gave a little information concerning the nitrogen-fixation plant of Synthetic Ammonia and Nitrates, Ltd., at Billingham. The directors, he said, were so satisfied with the process (a modified Haber process) that the work of erecting the plant had been proceeding as fast as possible for many months. Although operations had been hampered by the engineering lock-out, it was hoped to have the plant running early next year. For a considerable time past work on the new ammonia-soda plant had proceeded slowly at the Wallerscote factory, but latterly it had been speeded up, and as it was believed that prices had now reached an economic level, further orders had been placed for buildings and plant. Trade was undoubtedly improving, but the immediate prospect was not clear.

During the past year £2,500,000 of preference capital (all of which now bears 7 per cent. interest) was issued, and also £69,000 of ordinary capital in exchange for Castner Kellner shares. The total issued capital is now £13,647,041 and the balance sheet for 1920-21 shows an excess of assets over liabilities of about £17,250,000. The investment surplus reserve account, showing a credit of £1,600,000, has been closed, and disposed of by allocating £1,000,000 to a new capital reserve, £220,000 to general reserve, £379,898 to depreciation of stocks, and £129,776 to the expenses of the issue of new preference shares. The gross profit, after deducting £150,000 for depreciation, shows an increase over 1919-20, but in that year £264,000 was deducted for depreciation, so that this item was actually less, and also the net profit—£1,022,000. The dividend on the ordinary shares (9,647,041) is 8 per cent. for the year.

BRITISH DYESTUFFS CORPORATION, LTD.

The report of the directors for the year ended October 31, 1921, states that there was a net loss of £1,006,660 on the year's working. This amount is arrived at by deducting the sum of £1,444,313, written off stock values to reduce them to market prices, from £437,653, the balance of profit after providing £467,106 for depreciation and crediting an estimated sum recoverable in respect of excess profits duty. As the balance brought in from 1919-20 was £203,304, a deficit of £803,355 remains to be carried forward. Current financial resources are good, £1,250,000 being available at the Bank or invested in easily realisable securities.

The bad position is ascribed to trade depression, and the presence in the country of large stocks of dyes imported in the interval between the Sankey judgment and the enactment of the Dyestuffs (Import Regulation) Bill, and on "reparations" account. The directors have carried out all possible economies, much of the plant has been closed down, and they anticipate that when ordinary conditions of trade return the output from the factories will compare favourably with that of any other company. Research work under Prof. A. G. Green and Mr. J. Baddiley has been developed, the quality of the dyes produced has been improved and standardised, costs have been reduced, and some new and important dyes have been put on the market.

The reorganisation of the works and technical staff was carried out by Mr. G. Vernon Clay, who has recently resigned active control. Dr. J. C. Burnham has been appointed general works

manager. Sir William Aykroyd and Dr. H. Levinstein have resigned their seats on the Board.

Addressing the third annual meeting, held in Manchester on June 24, Sir William Alexander said that a system of single control was established in August, 1921, by the appointment of himself as chairman and managing director, assisted by Mr. G. V. Clay as manager of the works and technical staff. Mr. Clay's successor, Dr. J. C. Burnham, had had great administrative experience and was formerly general works manager at H.M. Factory, Gretna. The directors were satisfied that the Corporation possessed an adequate amount of scientific skill and experience which only required proper directing and harmonious working to secure satisfactory results. The company was now practically free from the heavy commitments, valued at about £800,000, which had been entered into in 1918-20 for plant extensions and the purchase of raw materials; and the total compensation paid to secure cancellation was less than £35,000. Economies amounting to about £200,000 per annum had been effected, and although large sums were still allocated to the research and technical departments, the directors were satisfied that expenditure under these heads could now be considerably reduced without loss of efficiency.

Referring to Dr. Levinstein's resignation, Sir W. Alexander refuted the contention that the company was now left without proper scientific and technical control, and regarding his own position, he said that though not an expert in dye-making, he had some knowledge of chemical manufacture and of the general principles underlying the successful conduct of business.

The prices charged for the company's dyewares were not excessive; they were the same for home and foreign consumers; they had fallen substantially since 1920, and at present they averaged 3s. 5d. per lb. The Corporation was not asking consumers to pay prices based on the present abnormal costs of production; for costing purposes, the prices charged were based upon an output three times larger than present sales; and these prices were not much higher than the prices quoted from Germany, if the difference between the internal and external values of the mark was taken into account. The policy of the Corporation would be to assist the dyer by every means in its power, consistent with the security of the industry. Informal discussions had been held with representatives of the German dye-making industry in order to effect a satisfactory working arrangement between the makers in both countries, but so far the German interests had proved unwilling to accept the fundamental principle that this country must possess a dye-making industry adequate to our needs both in peace and in war. In conclusion, Sir W. Alexander referred to mistakes which had been made in the management of the company's business in the period 1918-20 and to the improvements which had been effected since.

In the long discussion which followed, Sir Joseph Turner, whose re-election to the Board was not recommended by the directors, defended his former work as a managing director, criticised the balance-sheet in so far as it did not disclose trading losses, and stated that plant and machinery for making dyes required by this and other countries, and worth hundreds of thousands of pounds, were in the works and had never turned a wheel. An amendment to refer back the report and accounts and to institute a searching inquiry into the company's affairs was ruled out of order, and also another asking for the appointment of a committee of inquiry by the House of Commons. Mr. H. Sutcliffe Smith (chairman of the Colour Users' Association) said that the colour-users were absolutely determined on the establishment of the home

dye industry, and he suggested that the Government should wipe out its loan to the company, that the company should be reconstructed, and that eventually the management should be in the hands of those who had been bred and brought up in the business.

The resolution to adopt the report and accounts was carried on a poll by 2,320,637 votes to 1,086,000, irrespective of the Government's holding of 1,700,000 votes; and a resolution not to fill the vacancy caused by the retirement of Sir J. Turner was passed by a majority.

REPORTS.

REPORT OF THE FUEL RESEARCH BOARD FOR THE YEARS 1920, 1921. SECOND SECTION: LOW TEMPERATURE CARBONISATION. Pp. iv+73. London: H.M. Stationery Office. 1922. Price 2s.

In a general review of the present prospects of low-temperature carbonisation it is shown that there has been a sharp decline in the price of fuel oils and that at present this price is determined by circumstances outside the control of this country. It may be generally assumed that the coke as a domestic fuel will command a price sufficient to pay for the whole of the coal used in its production and that all manufacturing charges and profits must be paid out of the revenue from the crude oils and rich gas obtained. The gas would be particularly suitable for enriching low-grade gas to a higher standard of calorific value. Whether the process can be worked economically depends upon the evolution of an apparatus which can be cheaply erected, operated and maintained. After considering the various ways in which coal may be carbonised at low temperatures, it was decided to determine the results which may be obtained when crushed coal is heated in thin layers in an externally-heated retort. The movement of coal during carbonisation by means of a conveyor was not attempted because of the size and expense of the apparatus involved. Processes in which the charge is heated by the passage through the retort of hot producer gas result in the production of a large volume of low-grade gas for which an outlet for industrial purposes must be found.

A special study was made of the microstructure of cokes prepared from various coals and from blends of caking and non-caking coals, and a number of photographic reproductions are included in the report. It is shown that coke is a glassy mass possessed of a sponge cell structure of a porosity comparable with that of wood charcoal. A fusible coal which tends to foam and give a coko with an open structure may be made to yield a more homogeneous product by intimately mixing a less fusible coal with it before carbonisation. A more homogeneous product is also secured if the coal is crushed and briquetted under high pressure without a binder before being carbonised. It is suggested that this work is likely to lead to the establishment of a link between low-temperature carbonisation and the coking and metallurgical industries.

Full details are given of the retorts which were erected for carbonisation trials on a large scale. Each of these is 9 ft. long by 2.5 ft. wide and constructed of top and bottom curved steel plates riveted to 5-in. channels which form the sides. Each retort is set in a combustion chamber and a carbonising temperature of 600° C. was maintained by careful control of the combustion of fuel gas supplied through nostrils in the crown of the chamber. The coal was crushed to predetermined sizes and spread in trays 3 in. deep which could be pushed into the retort by means of suitable handling gear.

Attention was first concentrated upon the production of a coherent coke containing 8–12 per cent. of volatile matter, and this was attained with an evolution of 3000 cb. ft. of gas per ton of coal coal carbonised. From a study of the rate of evolution of gas at different temperatures it was decided that there was no advantage in raising the temperature above 600° C. or in prolonging the heating at that temperature. The cracking of hydrocarbon vapours even at this temperature was seen to be an important factor. The period of carbonisation was found to depend upon the ratio of mass to surface area of the coal layer. Layers less than 3 in. thick were not employed because of the influence of the rapid transfer of heat by radiation in preventing the general fusion of the surface layer. The conduction of heat into the centre portions of the layer was ultimately improved by dividing the mass into 3-in. cubes by means of a grid of steel strips. The elimination of the time element by the carbonisation of small particles by radiant heat would apparently open up new possibilities when the coke could be briquetted or used as a powder. After working with various sizes of particles the standard practice adopted was to take the whole output of a disintegrator, all of which passed a 4-mesh screen.

The results obtained with different coals are given in great detail and are compared with results obtained in the laboratory assay apparatus. The following is a summary of the yields obtained per ton of coal:—14.5 to 15.5 cwt. of coke, 13 to 17 gallons of crude oil, 7 to 15 gallons of liquor equivalent to 4.5–8.5 lb. of ammonium sulphate, and 3000 to 3500 cb. ft. of gas equivalent to 27–35 therms. The gas had an average calorific value of about 1000 B.Th.U. per cb. ft., and in one test the equivalent of 1.4 galls. of refined spirit per ton of coal was removed from it by stripping. The crude oil as collected contained emulsified liquor which could be separated after filtration. The yields of refined products were determined, and it was also shown that the crude oil could be rendered suitable for use as a fuel after a partial distillation to raise the flash-point. Its miscibility with other petroleum fuel oils is limited.

A carbonising machine was devised in which the coal trays are superimposed on shelves on an elevator movable vertically in a gas-tight chamber so that each tray in turn is brought opposite a charging and discharging device. Experience with this machine has shown that the carbonising period is increased from 3 to 4 hours owing to the reduction in the direct radiation of heat, and that in the mechanically moving steel parts there is a loss of rigidity at the working temperature of 600° C.

REPORT ON THE INDUSTRIAL AND ECONOMIC SITUATION IN CHILE, DATED DECEMBER, 1921. By W. F. V. SCOTT, H.M. Commercial Secretary, Santiago. Department of Overseas Trade. Pp. 102. London: H.M. Stationery Office. 1922. Price 2s. 9d.

The prosperity of the Chilean Republic depends on the nitrate industry, which furnishes 75 per cent. of the State revenue in normal times. About 55 per cent. of the total output is produced by Chilean companies and about 30 per cent. by British companies. Between 50,000 and 60,000 workers are employed in the nitrate works, which consume annually more than 300,000 tons of coal and 450,000 t. of petroleum. As previously reported in these columns, the industry was very depressed during 1921, and the outstanding event of the year was the conclusion of an agreement to regulate prices between the Producers' Association and the Nitrate "Pool." The Association, aided by the Chilean Government, has at last decided greatly to increase the expenditure on propaganda; the average sum spent hitherto is stated to have

been about £20,000 per annum, whilst the German manufacturers of nitrogenous fertilisers appear to have spent £300,000 on propaganda during 1920 alone. The growing competition between natural nitrate and competitive artificial products is well shown by the following figures:—

	Consumption.			
	1894.	1904.	1913-14.	1921
Chilean nitrate ..	73 ..	60 ..	56 ..	33
Competitors ..	27 ..	34 ..	44 ..	67

Chile is the second largest producer of copper in the world, and the industry is largely in North American hands. The American mines produce from ore assaying 1·63 to 2·16 per cent. of copper, but the British, French, and Chilean companies use ores with 8 to 25 per cent. Production of copper had to be reduced in 1921 owing to the slump in the market, and all the American mines closed down. The production of minerals and metals in 1920 was as follows:—

Gold, refined	Flue oz. ..	54,400
Silver .. ..	.. ..	2,608,086
Copper	Metric tons ..	99·5
Gold ore .. ..	.. ..	3
Gold and silver ore ..	.. ..	19
Gold, silver and copper ore ..	.. ..	296
Silver ore .. ..	.. ..	367
Silver and copper ore ..	.. ..	327
Copper ore .. ..	.. ..	24,769
Manganese ore .. ..	.. ..	11,632

Strikes during 1920 reduced the output of coal to 1,063,000 t., and the depression in the industry persisted during 1921. Coal consumption in Chile will be greatly diminished by the increasing use of electric power and by the adoption of petroleum, instead of coal, in the nitrate *oficinas*. The country possesses immense deposits of iron ore containing 60 to 70 per cent. of iron, but the impossibility of making coke from Chilean coal has prevented the establishment of an iron and steel industry. Preparations are being made by the Bethlehem Steel Co. to transport 3 million tons per annum of iron-ore for smelting in the United States. Considerable interest has been shown in petroleum-bearing lands, and the shale deposits near Lonquimay have attracted attention, but nothing has been done.

The principal crops are barley, wheat and beans; incomplete statistics for 1921 indicate an increase in the export of these products as compared with 1920. For sugar Chile is entirely dependent on Peru (90,000 t. per annum), but a company recently formed hopes within a few years to supply the country's requirements from sugar-cane grown in the Taena district, and another company is being formed to cultivate sugar-beet and manufacture beet sugar near Valdivia. Thanks to protective tariffs, Chile possesses a number of flourishing industries. Approximately 600,000 barrels of cement is manufactured annually, but very much larger quantities are imported. The match industry more than meets the demand. Of the three large glass factories, two manufacture bottles and demijohns, and the third miscellaneous articles including scientific glassware; production and importation are each valued at about £300,000 per annum. The sale of foreign soaps, candles, drugs, perfumes, disinfectants, etc. is very restricted owing to the import duties and the low rate of exchange.

The percentage distribution of the import trade in 1920, valued at \$455,078,934 gold pesos, was: the British Empire 31, United States 31, and Germany 5; and of the exports, worth \$778,885,230 gold pesos: the British Empire 21, United States 44, and Germany 10 (gold peso=18d.). Statistics for 1921 are not yet complete. At the date of the report the Chilean market was overstocked and depressed, and no revival was anticipated until the nitrate *oficinas* were reopened. There has been considerable trouble with labour.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for June, 8, 15, and 22.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REFERENCE NUMBER.
Argentina, Uruguay	Heavy chemicals, earthenware, plate glass	686
Australia	Glassware, paper, ink	412/20/7/303
"	Oils (paraffin B.P. and technical), pharmaceutical chemicals, glassware	690
"	Druggists' supplies, steel	†
Belgium	Fine chemicals, drugs, pharmaceutical products	701
British West Indies	Paint, varnish	8357/E.D./S.C.
Canada	Tinplate, galvanised sheets	780/37/F.G.
"	Portland cement	8814/E.D./M.C.
"	Porcelain insulators	
"	Paint, varnish, enamel, dry colours	693
Chile	Pharmaceutical preparations, drugs	670
Dutch E. Indies ..	Glass, glassware, pottery	225/18/F.G./M.C.
Hungary	Medicinal preparations, rubber manufactures	679
South Africa	Bituminous paint, gauge-glasses	675
Spain	Sugar, metals	654
Straits Settlements	Glacial acetic acid, pure hydrochloric acid, pure and commercial nitric and sulphuric acids, formaldehyde, potassium cyanide, chemicals for rubber manufacture, bottles	676
Sweden	Chamois and kid leather	659
United States	Cement, firebricks	15731/F.W./M.C.
"	Fertilisers (ammonium sulphate, etc.)	667
"	Linseed oil, caustic soda, soda ash	669
"	Glass, glassware	225/4/F.G./A./M.C.

* Canadian High Commissioner, 19, Victoria Street, London, S.W. 1.
† 412/20/7/3046. Official Secretary, Commercial Bureau, Australia House, Strand, W.C. 2.

TARIFF. CUSTOMS. EXCISE.

Antigua.—By an Ordinance dated April 5, the import duties on various kinds of spirits and non-medicated wines have been increased by 15 per cent.

Belgium.—Export licences are now required only for sugar, syrups, and molasses. Regulations have been issued controlling the sale of disinfectants and antiseptics not included in the pharmacopoeia.

Australia.—A reciprocal customs agreement has been made with New Zealand for the entry of goods from the United Kingdom under the British preferential tariff after transshipment from New Zealand to Australia and *vice versa*.

Canada.—The amendments to the proposed new customs tariff affect cacao products, refined sugar, newsprint paper, medicinal and pharmaceutical preparations, caustic soda, gasoline, certain wares of glass, and non-alcoholic preparations for disinfecting, spraying or dipping. It is proposed that various chemicals shall be admitted duty free and that the dutiable value of goods from countries with depreciated currencies shall be not less than the

value of similar goods produced in the United Kingdom.

Cuba.—Under the new customs tariff, it is proposed to abolish the *ad valorem* rates, to reduce the duties on raw materials, and to increase the duties on articles that are, or may be, made in Cuba, and on "luxury" goods.

Denmark.—It is proposed to revise the import duties on "luxury" articles such as cut glassware (except laboratory ware, incandescent lamps, optical glass), vanilla, vanillin and extracts thereof, wares of precious metals, etc. Various wares of porcelain and incandescent-mantle nets of silk are proposed to be exempted from duty.

Egypt.—Opium (except codeine), heroin, cocaine, coca, hashish, salts of these drugs, and preparations containing over 0.2 per cent. of morphine or more than 0.1 per cent. of heroin, cocaine, or hashish may not be imported save under special licence. Glucose may not be imported except under special licence.

France.—It is proposed to modify the customs duty on iron and steel products, but not on blooms, billets or bars, sheets, special steels and tinplate.

Greece.—Copies of decrees increasing taxation (except the revenue tax), and the monopoly and stamp duties may be consulted at the Department.

Italy.—The text of the revised regulations permitting the importation duty free of certain textile, metal and glass products, tinplate, sugar and glucose to be worked up for exportation within a short period, may be consulted at the Department.

Jamaica.—Under the new customs tariff, preferential rates are applied to explosives, candles, cement, glucose, matches, opium, animal, vegetable and mineral oils, salt, soap, alcohol, sugar, and vinegar produced or manufactured within the United Kingdom or Canada. Fuel, fuel oil, fertilisers, fungicides, disinfectants, quinine, salvarsan, scientific apparatus (not for sale), and paper may be imported free of duty.

Latvia.—Particulars of the duties levied under the new tariff may be obtained from the Department.

Martinique.—The import duties on petroleum products have been modified.

Morocco (French).—Denatured alcohol and methyl alcohol may only be imported under licence. Alcohol imported or manufactured in the French Zone may only be denatured with methyl alcohol supplied by the customs authorities.

Mozambique.—A duty of 10 per cent. *ad valorem* is payable on perfumes and essential oils imported for use in manufacturing soap.

South Africa.—The customs tariff is to be revised next year. Provision is made in the proposed Budget for preventing "dumping" from countries with depreciated currencies.

Switzerland.—Copper sulphate may be imported without special authorisation after June 15.

Tunis.—Crude and rectified methyl alcohol, acetone, and charcoal may now be exported to all destinations without special authorisation. Export prohibitions have been withdrawn from raw hides and skins, animal (not fish) fats, edible fats, feculæ, and molasses.

SWISS EXPORTS OF ARTIFICIAL SILK IN 1921.—The artificial-silk industry of Switzerland, represented chiefly by the Viscose Co., Emmenbrücke, was one of the few Swiss industries that increased their exports in 1921, the export in that year amounting to 836.6 metric tons, valued at 18,100,000 francs, compared with 335.3 t., worth 17,682,000 fr. in 1920. By value the export was distributed as follows:—United States 6,764,000 fr.; Great Britain 4,086,000 fr.; and Spain 2,122,000 fr. Imports of artificial silk amounted to 347.6 t., valued at 6,405,000 fr.

REVIEWS.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: A RETROSPECT 1831—1921. By O. J. R. HOWARTH, *Secretary*. Pp. vii+318. Published by the Association, Burlington House, London, W. 1. 1922. Price 7s. 6d. net.

It was the happy suggestion of Sir Charles Parsons, and his generosity, that led to the publication of this volume, and the difficult task of writing it has fallen upon Mr. Howarth. We can congratulate both of these gentlemen very warmly on the result. About eighteen months ago there occurred in the columns of *Nature* one of those periodical outbreaks, like sunspot maxima, when the British Association is declared to be going, if it has not already gone, to the dogs. A considerable number of people, generally of mature years, declare that it is not what it used to be. Whilst others reply that "it never was," various radical changes are suggested. And yet after all the cudgelling and prodding the staid old British Ass. goes steadily on its way.

The most censorious critics of the British Association are a section of scientific men who rarely, if ever, attend the meetings and who never have caught the spirit of them. It is not easy to communicate that; you need to have begun early and to have grown through the several ages of scientific life before you can appreciate what the British Association stands for. Yet Mr. Howarth has gone a long way towards giving an embodiment in prose of its quite peculiar characteristics. He has shown an admirable sense of proportion and catholicity and has evidently taken great pains to get to the right sources of information. His book is an excellent and thoroughly readable piece of scientific history, and reflects in a form that will be permanently useful the position of science in Britain during the Victorian age. He records the early struggles of the Association against the coldness of a section of the old universities, against the irony of *The Times*, the mockery of Charles Dickens and the apathy of many scientific men themselves. He brings into relief that admirable and scarce type of man which has done, and can do, so much for science—the man really eminent as a discoverer, and withal of commanding personality, with wide human sympathies and a strong sense of public duty.

So far as chemistry is concerned there has been of course no room for detailed record in Mr. Howarth's book, but enough is said to exhibit the aid which the science has received by the work of the Association. We read of the participation of Dalton at the very outset. There is a quotation from a letter of Murchison's alluding to "old Dalton, atomic Dalton" reading his own memoirs and "replying with straightforward pertinacity to every objection in the highly instructive conversations which followed each paper," and a long excerpt is given of the fine eulogy of Dalton pronounced by Sedgwick from the presidential chair in 1833. We are reminded of Section B's valuable reports and discussions, including the chemical phenomena of the blast furnace, electrolysis, solution, colloids and various topics of organic chemistry. A few of us may remember the wonderful Sheffield lecture by Crookes in 1879 on Radiant Matter; many will remember the first appearance of fluorine in England at Nottingham in 1893 and the startling announcement of the discovery of argon at Oxford in 1894. The great chemical meeting when the Association met in Manchester in 1887 under Roscoe's presidency brought to our shores Mendeleeff, Menschutkin, Lother Meyer, Pittig, Wislicenus, F. W. Clarke and a host of others. The joint discussions on borderland topics with Section A

have been perhaps as interesting and valuable as anything in the history of British Association Chemistry and never more so than at the present time as was shown both last year at Edinburgh and the year before at Cardiff. The Association has never concerned itself very directly with applied chemistry but it has been fortunate in securing the allegiance of many of the leaders in chemical industry and it has been, especially in earlier days, a very useful agency for bringing scientific men into personal relations with men of the manufacturing world.

Perhaps the most conspicuous omission in Mr. Howarth's book is that of adequate reference to the line of men to which he himself belongs—the permanent officials, who behind the scenes have worked so steadily with quiet enthusiasm and with such success to keep the complex organisation in smooth working order. It makes a demand for many talents in its officers, and it has been singularly fortunate. Everyone who believes in the Association and the multitude who have profited from it will feel grateful to Mr. Howarth for the excellent story he has told. He has allowed little of his own partialities to appear and has hinted at few prescriptions. There is, however, one that deserves prominence, namely the suggestion that the address of the President might be handled according to the example given by A. C. Ramsay at Swansea in 1880. On that occasion the President laid aside his address and spoke from a few notes. The present writer looks back upon an experience of twenty-two British Association meetings, and in the retrospect can recall few inaugural addresses that were not intolerably long. It is a pity to begin the week's meeting by so heavy a tax on the endurance of a vast audience, many of whom are really your hosts, and it seems greatly to be desired that if a President cannot be trusted to speak from notes, the omissions from the printed address should be much more liberal than they have been.

ARTHUR SMITHELLS.

THE PETROLEUM INDUSTRY. *A brief survey of the Technology of Petroleum based upon a Course of Lectures given by Members of the Institution of Petroleum Technologists on the occasion of the Petroleum Exhibition, Crystal Palace, 1920. Pp. vi.+346. (London: The Institution of Petroleum Technologists. 1922). Price 14s. 6d. net.*

The Institution of Petroleum Technologists, since its inauguration in 1914, has steadily pursued its avowed policy of promoting the better technical education of persons desirous of engaging professionally in petroleum technology. The Petroleum Exhibition of 1920 afforded an opportunity for educational propaganda in a wider sphere of popular interest, and the course of seven lectures given with this object, together with considerable additional matter, forms the basis of the volume under review.

The work is dedicated to the late Sir Boverton Redwood, and a gracefully-worded tribute to the first president of the Institution is accompanied by facsimile signatures of the eleven contributors to the book. A paper entitled "The Romance of Petroleum," delivered by Sir Boverton at the Royal Institution in 1918, is included in the book, and this, together with the introductory lecture by Sir Frederick Black, provides an interesting survey of the general subject, and prefaces the more solid matter contained in the succeeding chapters. The range covered by the latter is very wide, and the joint authors are to be congratulated on their ability in condensing such a wealth of information into such a small space.

Viewing the book as a whole, the disadvantages of multiple authorship are somewhat apparent. Some of the subject matter is dealt with repeatedly by different contributors, and sometimes under headings to which it does not properly belong. There are numerous examples of this overlapping, and the work lacks a certain degree of homogeneity on that account. Then again, divergencies from a uniform style of treatment by the various contributors are very much in evidence. Some of the chapters are so replete with technical terms and details that they do not fall far short of the standard required of a technical paper to be read before a learned society.

On the other hand, many chapters are eminently popular in style, and thus fulfil the original definition of the lectures as "popular descriptions." The chapters on "Wild Catting," "The Winning of Oil," "The Uses of Heavy Oils," and "The Uses of Petroleum Gases, Petrol and Paraffin" fall well within the latter category, the last-named being especially lucid in treatment. It is doubtful, however, what information would be conveyed to the lay mind by the allusions to "Maetra of Bignoniania Sinz" (page 60), or to "Akchagil and Spaniodontic beds" (p. 61), whilst "Nastukov's formolit" (p. 206) and "Dodecahydrodiphenyl" (p. 199) might only serve to intimidate the uninitiated! Then again, Fig. 11. (p. 64) "illustrating the variation of the halo of the apex-locus," would perhaps be more informative if some allusion to it were found in the text! The chapter on Nomenclature is very welcome and attempts to remedy the present chaotic state of petroleum terminology; it could have been extended with advantage.

It is difficult to assign a definite place for this book in the literature. At least 25 per cent of it would be unintelligible to the general reader, whilst to the fully fledged petroleum technologist the greater part would be superfluous. The student or embryo technologist might, however, derive much benefit and mental stimulus from its pages and be led to utilise the excellent selection of text-books set out at the end of the work.

Undoubtedly the volume fulfils the promise conveyed on its title-page to provide "a brief survey" of the subject; it is, however, a little unfortunate that the surveying instrument has by some contributors been of the nature of an opera glass whilst others have preferred the microscope. The book is well printed, profusely illustrated, and contains few typographical errors.

J. McCONNELL SANDERS.

MESSUNG GROSSER GASMENGEN: ANLEITUNG ZUR PRAKTISCHEN ERMITTLUNG GROSSER MENGEN VON GAS- UND LUFT-STROMEN IN TECHNISCHEN BETRIEBEN. By L. LITINSKY. Pp. xvi.+274. (Leipzig: Otto Spamer, 1922). Price, paper, 525 mk.; bound, 585 mk.

Gases "obey" Boyle's and Charles' Laws: and all measurements of gaseous volumes are to be reduced to conditions represented by the letters N.T.P. by the rigorous application of these laws. So we were taught in our early school days. Later it was borne in upon us that the word "obey" was rather misused in this connexion, for we learnt that all gases appeared to have more or less of a will of their own, and to "disobey" the gas laws to a greater or less degree accordingly. Their disobedience was investigated, amongst others, by Regnault, Amagat and Andrews, and as a result of the researches of these physicists, it is possible to calculate with extreme precision the correction to be applied to a volume of gas measured over a very wide range of temperatures and pressures.

The measurement of stagnant volumes of gases nowadays presents little difficulty, provided the measured volume is not large. Set the gas in motion in a pipe or channel and the measurement is one apparently beset with difficulties. Why should this be so? Hardly because of insufficient time devoted to the study of the subject. The Pitot tube was introduced in 1732; the Venturi tube dates from 1791; hydrodynamics as a field for the study of new problems is practically exhausted. The difficulties mentioned arise from the general lack of appreciation of the laws of fluid motion. That precise measurements of moving masses of gas can be accurately made is obvious if we but consider the achievement of manufacturers of towns' gas in this direction. Generally, however, the measurement of the volume of a gaseous component of a reaction—and particularly if the component in question is air—is considered to be unnecessary on account of the small monetary value of the gas. Consequently, even should the measurement be attempted, the determination is often made in a manner rendering the results of little, if of any, value. A workman armed with an impossible Pitot tube, or perhaps with a windmill type of anemometer that might fitly be labelled "found in the trenches," and more than one industrial firm has achieved a rocketing reputation for being advanced and scientific!

The present volume can be heartily recommended. It should appeal especially to the chemical technologist, as throughout the practical aspect is kept well in the foreground. The subjects dealt with comprise the properties of gases, measurement of and recording the specific gravity of gases, measurement of pressure, a short account of wet and dry gas-meters, various indicating and recording types of anemometer, Pitot and Venturi tubes, jet meters, calorimetric electric meters, various stoichiometric and chemical methods, rotameters, etc. The section devoted to the recent development of the various forms of electric meters should be somewhat amplified. Incidentally, it may be remarked that the theory underlying the electric meter of C. C. Thomas cannot be regarded as satisfactory in the form given by the inventor of the meter, and as reproduced in the present volume.

Each chapter concludes with a most valuable comparison of the relative merits and demerits of the various types of instruments described. The various characteristics of the twenty-one types discussed are finally summed up in a comprehensive table tabulating such factors as space taken up by the installation, pressure necessary for operation, whether indicating or recording, degree of accuracy obtainable, suitability or otherwise for use with gas at high pressure, etc.

There is comparatively little reference to English work and authorities on the subject. The few English references given need revision, more especially in regard to spelling. Almost without exception every English reference in the list of the literature of the subject is badly misspelt.

In the matter of translation the activities of the Department of Scientific and Industrial Research appear to have been confined hitherto almost exclusively to optical works. The present volume may be commended to the Department as one worthy of its consideration with a view to making it more generally available to English technologists.

J. S. G. THOMAS.

CORRIGENDA.—In the issue for June 15, 1922, p. 238 R, col. i, l. 3—5, read "when the supply of 'turpentine' camphor ceased during the war the price of natural camphor increased sixfold"; also p. 242 R, col. ii, l. 11—12 from bottom, read "more accurately in artificial daylight than in ordinary artificial light."

OBITUARY.

WILLIAM GOWLAND.

Prof. William Gowland, the *doyen* of scientific metallurgy in this country and an original member of this Society, died at Kensington on June 9, 1922. He was born in 1842, and was educated at the Royal College of Chemistry and the Royal School of Mines, where he obtained his Associateship and the De La Beche medal for mining in 1870. In 1870-72 he was chemist and metallurgist to the Broughton Copper Co., Manchester, and in 1872-89 he was at the Imperial Japanese Mint, Ozaka, at first as Metallurgist and afterwards as Assayer, Metallurgist and Chief of the Foreign Staff. He was also for some time adviser to the Imperial Arsenal, Japan. After his return to England he was chief Metallurgist to the Broughton Copper Co. for a few years, and became professor of metallurgy at the Royal School of Mines in 1902, continuing as emeritus professor after his retirement in 1909 until his death.

While in Japan, he made many exploratory expeditions in that country and in Korea, and made first ascents of several mountains, usually without companions, as the Japanese did not favour such proceedings. His chief interests, however, outside the Mint, lay in the study of the ancient metallurgical processes of Japan which were not appreciably displaced by Western methods until after 1884. He examined thousands of metal statues, bells, vessels, ornaments, weapons, trappings, and other articles, of all ages from 700 B.C. downwards, determining their composition and method of preparation wherever possible. Some of the results of his labours are given in the *Transactions of the Japan Society*. He became a leading authority on the metallurgy of the ancients generally, and read a number of important papers on the subject before the Society of Antiquaries and the Anthropological Institute. Other papers of his were read before this Society and the Chemical Society. He also published a book on the metallurgy of the non-ferrous metals.

At the Royal School of Mines his teaching was of a strikingly practical kind, especially with regard to the design and working of roasting and smelting furnaces, and he endeared himself to his students and his large circle of metallurgical friends by his unfailing geniality and good nature, and by his infectious enthusiasm for work.

He was a Fellow of the Royal Society and of the Institute of Chemistry, President of the Institution of Mining and Metallurgy, 1907-8, of the Institute of Metals, 1912-14, and of the Royal Anthropological Institute in 1905-7. In 1889 the Order of the Rising Sun of Japan was conferred on him, and in 1909 he received the gold medal of the Institution of Mining and Metallurgy.

T. K. ROSE.

PUBLICATIONS RECEIVED.

PRACTICAL TANNING. By DR. A. ROGERS. Pp. 699. (London: Crosby Lockwood and Son. 1922). Price 45s. net.

ANORGANISCHE CHEMIE. Ein Lehrbuch zum Weiterstudium und zum Handgebrauch. By PROF. F. EPHRAIM. Pp. 727. (Dresden and Leipzig: Theodor Steinkopff. 1922). Price, paper, 21s. 6d., bound, 24s.

TESTS ON RANGES AND COOKING APPLIANCES. By A. H. BAKER. Fuel Research Board. Special Report No. 4 Department of Scientific and Industrial Research. (London: H.M. Stationery Office. 1922). Price 2s. 6d.

SOCIETY OF CHEMICAL INDUSTRY.

FORTY-FIRST ANNUAL MEETING IN GLASGOW.

The annual meeting held in Glasgow from July 4 to 11, 1922, resembled that held in the same city exactly twelve years previously in that on both occasions a distinguished chemist from North America occupied the presidential chair; Prof. Ira Remsen enjoyed that honour in 1910 and Prof. R. F. Ruttan in 1922. Since the former year, however, the thoughts of home chemists have been widened by an ever-growing recognition of the importance of the Anglo-Saxon condominium, and it is not too much to say that the extremely cordial welcome accorded to Dr. Ruttan was not only an expression of good will and appreciation of his high personal qualities and attainments, but an acknowledgment of the fact that he represents one of the earliest and greatest of the nations constituting the British Commonwealth. The ovation which was given Dr. Ruttan when he was entertained by the London Section at Oddenino's Restaurant on June 26, and which was repeated at the dinner and meeting in the Hotel Cecil on June 28, reached a fitting climax when he took the chair at the Annual General Meeting held in the fine hall of the Institution of Engineers and Shipbuilders on July 4 in Glasgow.

In addition to Dr. Ruttan, Dr. Ellwood Hendrick, of New York, the envoy of the American Section, received a very cordial welcome, and the entire proceedings were graced by the presence of a number of foreign guests, among whom were noted Col. W. R. Lang, of the University of Toronto, Mr. F. E. Cornell, Montreal, Prof. L. F. Goodwin, of Queen's University, Kingston, Mr. A. Lucas, director of the Government Laboratory, Cairo, Messrs. H. Wigglesworth and J. V. N. Dorr, New York, Mr. A. E. Gibbs, Philadelphia, Mr. H. A. Galt, Ohio, Messrs. W. J. Craig and A. G. Byard, from Spain, and Mr. J. H. Marshall, from Switzerland. The attendance of home members was thoroughly representative, and the crowded meetings afforded evidence, if such were needed, that the Society has lost none of its popularity and influence among chemists or their half-brothers, the chemical engineers, and among those who walk in their wake.

Particularly noteworthy features of the meeting were the President's address, the inaugural Messel Memorial Lecture, and the Conference of the Chemical Engineering Group. The numerous social functions and other diversions proved exceedingly popular and the whole programme, both in its conception and execution, reflected the very greatest credit upon the Committee of the Glasgow and West of Scotland Section, its chairman, Mr. J. H. Young, technical chemist to the Cassel Cyanide Co., Ltd., and its hon. secretary, Dr. J. A. Cranston, lecturer in physical chemistry in the Royal Technical College, Glasgow. It is difficult to bestow too much praise upon all those who were responsible for or who helped in the organisation of the meeting, but to each and all the President and Council, speaking in the name of the entire membership, wish to convey their very great appreciation and sincere thanks, and to assure them that "Glasgow, 1922" will long remain in their memories as one of the very best meetings that the Society has ever held. In this connexion especial mention must be made of the generous hospitality, which was

offered with true Scottish geniality to members and guests, including the ladies, by the Rt. Hon. the Lord Provost of Glasgow, Mr. Thomas Paxton, LL.D., who in several speeches showed that he fully appreciated the value and potentialities of chemical science and industry; the Corporation of Glasgow; the Governors and Staff of the Royal Technical College; the directors of Nobel Industries, Ltd.; the Clyde Navigation Trustees; the Council of the Institution of Engineers and Shipbuilders, for the use of its fine building; David Perry, Esq., a former Lord Provost; the directors of Provincial Cinematograph Theatres, Ltd.; and a number of private individuals whose generosity contributed materially to the great success of the meeting. Nor must we forget to mention the very useful Handbook, edited by Dr. Cranston for the Local Executive Committee, which contained not only the detailed programme and all the necessary information concerning the city and neighbourhood, but a valuable account of the chemical and allied industries of Glasgow and the West of Scotland from the pen of Mr. W. H. Coleman.

Annual General Meeting.

As the full report of the proceedings of the annual general meeting appears, by traditional right, in the Transactions (this issue pp. 209-219), a short summary will suffice in this place.

The civic welcome extended by the Lord Provost and the President's reply were models of terse and apt expression; the Report of the Council was taken as read and adopted unanimously on the motion of Mr. Young, seconded by Mr. Grant Hooper; and the Hon. Treasurer's report, which disclosed a very favourable financial position but a prospect of diminished revenue, owing to the prolonged industrial depression, was also well received. The congratulations to Mr. E. V. Evans were voiced by Dr. S. Miall and Mr. F. H. Carr. The nominations of the Council for the election of president and vice-presidents were approved unanimously, and the ballot for the election of members of Council resulted in the filling of the four vacancies by Mr. J. H. Young, Dr. A. Holt, of Liverpool, Mr. W. A. Williams, of Edinburgh, and Prof. W. R. Hodgkinson, of London.

Presidential Address.

Dr. Ruttan prefaced his address with an expression of thanks for the honour conferred upon the Canadian Sections by his election to the presidency, and laid stress on the good results which had followed the holding of last year's annual meeting in Canada. After a short reference to the international organisation of science, he approached the main topic of his address, the organisation and development of scientific and industrial research. Beginning with the establishment of the parent nation's Advisory Council in 1915, he traced the various movements which had developed in Australia, South Africa, New Zealand, India, and Canada. The remainder of the address was devoted to a discussion of the fundamental problems connected with this branch of national activity, such as the nature and permanency of State-aid, the functions of central institutions, and the respective spheres of action of research associations and universities. In Dr. Ruttan's view, research in both

pure and applied science should become one of the accepted responsibilities of the State, and the necessary financial support should be given with the same degree of certainty, permanency, and freedom from politics that is accorded other enterprises of a vital national character. On the motion of Dr. E. F. Armstrong, president-elect, a very hearty vote of thanks was accorded to Dr. Ruttan for his valuable address (*cf.* pp. 211—218 *r* of this issue), which will undoubtedly be widely read by all interested in this important subject.

After the meeting luncheon was served to over 300 members and guests in the Grosvenor Restaurant by invitation of the Glasgow Section. Mr. J. H. Young presided and made an excellent speech of welcome, to which Dr. Ruttan replied. Similar but more informal luncheons were held on the two following days, at one of which Sir David Macalister, Principal of Glasgow University, was the chief speaker.

In the afternoon of the first day members and guests attended a garden party at The Knowe, Pollokshields, by invitation of David Perry, Esq., the attractions including a band, Highland dances, bagpipes and other purely Scottish delights. The same evening the Lord Provost and magistrates of Glasgow entertained the Society at a reception in the palatial Municipal Buildings. After introductory speeches by the Lord Provost, Dr. Ruttan and Mr. J. H. Young, the guests separated, according to age and inclination, into two groups, one engaging in the dances in the Banqueting Hall and the other listening to a concert of really excellent vocal music, given by the Glasgow Select Choir, and conducted by Mr. Herbert G. Cross.

MESSEL MEMORIAL LECTURE.

On the morning of July 5, Prof. Henry E. Armstrong delivered the inaugural lecture devoted to the memory of the late Dr. Rudolph Messel. The President, having explained the nature of the bequest to the Society, presented to the lecturer the memorial medal, which has been designed by the well-known artist, Mr. E. Gillick. Sir William Pope referred to Dr. Messel as a pioneer in technical chemistry, and to Prof. Armstrong as a pioneer in technical education who had done probably more than any other to improve the quality of science teaching in this country.

The lecture, entitled "Rhapsodies culled from the Thionic Epos, including a discussion of the conditions determinative of Chemical Interchange," proved of absorbing interest; it covered, directly and incidentally, a wide range of topics, and was composed in that incisive, perspicuous and literary style of which the author is a master. Iconoclastic and constructive, retrospective and prospective, satirical and appreciative, the lecturer carried his large audience with him and well achieved the *aliquid certi* he had in view, namely, to lay a foundation and set an example. To equal a predecessor, it has been said, one must have twice his worth; succeeding Messel lecturers will need far more. As the lecture is long and will shortly be printed in the *Transactions*, it is not proposed to desecrate it by presenting it here in abstract form; it must suffice to state that it consisted mainly of a record of the life, work and character of the Society's generous benefactor and the lecturer's intimate friend, and critical but constructive dissertations on chemical action, catalysis, and sulphuric acid. That those who were not present may glean some crumbs which fell from the rostrum, we append a few of the shorter "rhapsodies" as samples of the rest, and assure them that had they heard the applause with which the vote of thanks, proposed by Prof.

G. G. Henderson, was received, they would share with the writer the view that only one opinion was possible concerning the success of the First Messel Memorial Lecture.

Messel was the first to give platinum full industrial use; this was his great achievement. . . . A man of astounding vigour and full of feeling, he burnt the candle at both ends and all over its surface.

Platinum may well become the bond of union between the sexes. . . . Gold has led woman to minister to man in the past; why not platinum in the future, especially as our gold is now reduced to paper which cannot be worn with effect as jewellery?

To save the world from a Russian fate, science must be made as constructively effective in commanding human nature as it has been hitherto in hurrying the nations to their ultimate destruction.

The chemist alone, through his thionic influence, has made the Northcliffe press possible, the destruction of forests certain.

The pages of our chemical journals are full of careless writing—of careless writing due to careless thinking.

Everything seems to be now a sort-of-a-kind-of what it used to be; canned goods have captured the world and impudent advertisement counteracts conscience.

We must never forget that the laboratory worker is an artist and that, as a rule, practice comes first; so-called theory is usually brought to the aid of practice, in justification of its acts.

All single things dealt with by the chemist are chemicals. A chemical can only be defined as a material which can take part in a chemical change; combustion undeniably involves chemical change; oxygen is a chemical. Who manufactured oxygen? We can only say—It is!

Don't let us think of Lavoisier merely as a man who heated mercury in air and lost his head; think of him as the pioneer who not only sought to put system into the souls of chemists but also tipped their tongues with harmony.

Every text-book lies in telling the student that hydrogen and oxygen interact to form water.

There is nothing dogmatic in the assertion that all chemical change is an electrochemical, i.e., an electrolytic, process.

Altars have been set up everywhere for the worship of a narrow doctrine mislabelled Physical Chemistry; the chief ikon has been St. Arrhenius, a divinity of Scandinavian origin; Teutonic priests, the Ostwalds . . .

A horrible pedantic jargon has been piled up around ethylic aceto-acetate and other compounds which can lead a double life, beginning with the word "tautomerism": an unnecessary invention.

Hydrogen-ion-concentration is pure gibberish, a chord that cannot be struck upon "the lyre of language clear."

Following the lecture, Mr. W. J. U. Woolecock took the chair and Dr. J. W. McDavid read a paper on "A Rapid and Accurate Method for the Calibration of Storage Tanks." The principle of the method is that water flowing through a tube or orifice under a constant head gives a constant rate of flow. By calibrating the instrument with a particular nozzle, the rate of flow can be determined accurately, so that by observing the time taken to fill a tank to a given level, the volume up to that level can be readily calculated. The apparatus weighs only 26 lb.

Dr. R. A. Joyner followed with a paper on "The Viscosity of Cellulose in Cuprammonium

Hydroxide." The author, using a modification of the method devised by Gibson, Spencer, and McCall (J.C.S., 1920, 117, 484) has found that the viscosity of the cellulose solution diminishes as the copper content increases up to a certain limit, the concentration of the cellulose and ammonia being kept constant; that the viscosity falls as the concentration of ammonia increases, when the concentration of the cellulose and copper remain constant; but that the viscosity rises as the concentration of cellulose increases, the concentration of copper and ammonia being kept constant. The action of sodium hydroxide on the viscosity of cellulose was studied at different temperatures with varying concentrations, and on the assumption of the presence of two celluloses of widely different viscosity, the reaction appeared to obey the monomolecular law. No degradation products of cellulose were formed when the viscosity was lowered by the addition of N/30 and N/100 sodium chloride solutions at 100° C. A simple relationship was found for the action of air on cellulose dissolved in cuprammonium hydroxide; and the viscosity of the solution was reduced very quickly and without formation of oxycellulose by adding sodium hypochlorite in alkaline solution.

After lunch, members were privileged either to inspect the Dalmarnock Power Station, which supplied last year 151,688.636 B.O.T. units to private consumers, or the Provan Chemical Works, which is one of four plants owned by the Glasgow Corporation for working up by-products of gas manufacture. The Provan Works is the largest and has been completely reorganised during the last two years under the direction of Mr. W. A. Walmsley, with the result that the City is now reaping a handsome profit from the distillation of tar and ammonia. A description of the works is given in Mr. Walmsley's paper read before the Chemical Engineering Group (cf. i.).

ANNUAL DINNER.

The annual dinner was held in the Grosvenor Restaurant on July 5, Dr. Ruttan presiding over a very large company, which filled the large dining hall to its capacity. Among the guests were the Rt. Hon. the Lord Provost and Mrs. Paxton, Sir John Reid, Sir John S. Samuel, Dr. Ellwood Hendrick, and Dr. H. F. Stockdale.

After the loyal toasts had been honoured, Dr. E. F. Armstrong, in proposing "The Society," said it had been stated in the Press, and particularly in *The Times*, that we had no technical ability in this country. In rising to propose the toast of the Society of Chemical Industry, he felt bound to refute with all the energy at his command the suggestion that we have not in this country technical ability and aptitude both to invent and to carry out commercial operations. He declared that we have in Great Britain aptitude and ability to carry out any process under the sun; that we do not want to import, introduce, smuggle or convey under any Act of Parliament, under any definition, with or without duty, any kind of foreign chemist, foreign idea or foreign brains into this country. The trouble of chemists was that they did not advertise themselves, and if they would only adopt some of the usual methods of advertisement things would be very much better. The thing that had struck him in Glasgow was the very fine building belonging to the Institution of Engineers and Shipbuilders, and he hoped they would all leave Glasgow with a vow that they would leave no stone unturned until the chemical societies of this country had such a building. He coupled with the toast the name of their President, Dr. Ruttan, whose virtues had been sounded sufficiently already.

Dr. Ruttan, responding to the toast, spoke of the manner in which the Council had carried on the work during the year while he had been in Canada,

and especially thanked Sir William Pope, who had acted as Chairman of Council during that period. The affairs of the Society were in a very flourishing condition, as were those of the five sections in Canada, where a General Council had been formed to keep these Sections in closer touch with each other. The result of the work of that General Council was that a meeting had recently been held in Ottawa at which some 100 members from all parts of Canada had attended. It was very important in the interests of the parent Society that this should be done. He read a letter of greeting from this General Council sent from this first meeting, and added that the relationship between the Sections in Canada and the parent Society were very much those of the Overseas Dominions to the Mother Country, bound by bonds of affection but without a constitution, which made them loyal supporters of the parent Society in the one case and the Mother Country in the other. He expressed his complete agreement with what Dr. Armstrong had said regarding advertisement and bringing the claims of chemistry more prominently before the notice of the public, as only in that way would they be able to influence the legislature by bringing forward a strong body of public opinion. Time would not permit him to discuss many matters he would like to, but there was one point he would bring up. The suggestion he wished to make before leaving the chair was that renewed efforts should be made to emancipate the chemists of the universities of the Empire from the domination of German reference books. This had every prospect of success at the previous meeting of the International Union of Pure and Applied Chemistry, but for some reason we in the Empire had not taken a very active part in that very important undertaking. The question had been asked, especially in America, Why duplicate these books of reference? The German books, although leaving much to be desired, were cheap and readily available. There were several reasons for this course of action. The domination by Germany of the reference shelves in the scientific libraries of the world had been an important factor in attracting graduate students to German universities and thus inoculating to a certain extent the universities of the Empire with the German method. Many examples had been quoted, especially in chemistry, where the characteristic chauvinism of the German editors had been so strong as not only to lessen their appreciation of the work of other nations, but also their accuracy in recording achievements of the "Ausländer." That we should be in possession of English summaries of the chemical literature of the last seven years at the earliest possible date was a matter of which the importance was fully appreciated, and no more opportune time to break with the tradition of viewing chemistry "through German eyes" was likely to arise. The longer we waited the more difficult would be the task. Even if the German compendia were impartial there would still remain the objection that, to younger chemists, at any rate, the habit of consulting German works of reference—in default of others—leads by mass suggestion to an appreciation of German effort in chemistry which was by no means warranted by the facts. Moreover, the German compendia were not impartial. The almost exclusive use of German compendia and monographs throughout the whole civilised world had given that country a world-wide influence and prestige out of all proportion to the value of its contributions to knowledge. He hoped that in future students in the Overseas Dominions and the Mother Country would be encouraged to complete their studies in one or the other, and that the courses might be sufficiently attractive to draw students from England to complete their studies at the universities in the colonies. It must be known throughout the Empire that British chemistry was

better than German chemistry. It must be known throughout the Empire that there were greater opportunities for gaining knowledge of chemistry in England than there were in Germany. That being the case, he felt sure that it would be possible to establish within the Empire reciprocity between the various universities which would enable us to maintain the prestige of English chemistry and to increase very largely the number of men who were advancing in the higher branches of the science.

Sir William Pope, proposing "The City of Glasgow," spoke of the splendid hospitality which the Society had received at the hands of the Corporation and of all those connected with the meeting in Glasgow.

The Lord Provost, replying, said the Corporation of Glasgow was always willing to welcome societies such as this whose work so closely affected the health of large cities; none more so than the work of chemists. Glasgow had a very dense population, and they wanted all the assistance they could get from the chemical societies and scientific research men to help them in their endeavour to make the city more healthy.

Mr. W. J. U. Woolcock proposed "The Honorary Secretary of the Glasgow Section," and referred to the smooth manner in which all the arrangements for the meeting had worked.

Dr. J. A. Cranston acknowledged the toast and said that everybody connected with the task had done their share and that without that help the work could not have been done.

Mr. E. V. Evans proposed "The Glasgow Section." Mr. J. H. Young, responding, said that the members of the Section in Glasgow felt that they would like to see a definite step forward as the result of this meeting. They could not expect to add many new members at the present time owing to the trade depression, but a great deal of good would be done if joint meetings with the sections of other societies could be arranged. For instance, the Glasgow Section of the Society of Chemical Industry might arrange to hold joint meetings with the Institute of Chemistry; and the same applied to Edinburgh, and the meetings might be held alternately in Glasgow and Edinburgh. This idea of joint meetings might be pushed a great deal further than it had been hitherto and should be applied to such places as Liverpool and Manchester, and elsewhere in the case of towns in close proximity. The plan might be adopted in South Wales also, and in that way much good work remained to be done.

Prof. G. G. Henderson, who proposed the toast of "The Visitors," coupled with it the name of Dr. Ellwood Hendrick, and also suggested that telegrams of greeting should be sent from the meeting to the chemists of Canada and the United States.

Dr. Ellwood Hendrick, in reply said:—

From across the deep waters I bring you greetings and the assurance of all good will and fraternity. I shall ask you to take this statement for granted and the message as delivered, because in addition to the felicitations of ceremony and the message from our hearts, I bring also a problem and seek its solution.

In what follows I shall speak only of conditions in the United States. Whether these obtain in similar or in less measure here or elsewhere in British possessions you will know far better than I. The problem has to do with the great gulf that lies between the profession of chemistry and its business. As corporations grow in magnitude, this gulf threatens to become even wider; and since Mr. Young touched upon the subject yesterday I venture the belief that you are not total strangers to it.

We study long and ardently to attain proficiency in science and in its practice. On the other hand, in science, no proficiency, no competency, and sometimes not even character, is demanded of him who

would engage in the business of chemistry. So long as he can offer or borrow money he is welcome. This is because the need of chemical development is so urgent for the welfare of every industrial nation that we do not dare place hindrances in the way of it. The situation follows, however, that the business rules the profession; rules it in its own field. This is not true of all chemical enterprises by any means, but it occurs so frequently that gross ignorance directs chemical practice, that I venture to make this general statement: in the United States the weakness of chemical industry is not in the works, or in equipment, or in labour, or in engineering skill, or in the chemists themselves; it rests in the boards of directors of chemical establishments.

Corporations have the unfortunate habit of what we call window-dressing, in which men who have achieved success in any walk of life are thought to assure it also in chemical industry. Thus, a successful banker, stockbroker, lumber merchant, mine owner, and what-not are invited to join the board in the belief that the public will follow the mistaken idea that astuteness will conquer in spite of ignorance.

In no other great profession than ours does this situation exist. Imagine if you will a sick man sending for a physician and demanding that he punch a time clock coming and going, that he be paid according to the time spent in reaching his diagnosis; and that he prescribe treatment wholly according to the patient's whim and desire; or of a client insisting that his counsellor at law shall construe the law according to his wish and not as it is written.

The control of chemistry by business has reached such a pass that I have known a speculator in the industry to destroy the entire research organisation of a great establishment engaged in the most difficult and involved scientific processes, and to consult an excavation engineer for enlightenment as to how the works should be operated.

The future of the industrial nations rests with their chemists. According as they are more or less men of wisdom and understanding, and above all things men of character, industry will flourish or fade away. We cannot ask for all of these standards from the man who represents the investment of capital alone.

Now the last thing we want to do is to restrict the rights of property, or to destroy initiative. But chemical industry is a professional institution, and it cannot flourish if it is ignorantly directed. Chemical vision and understanding are required of it if it is to prosper. And the looting of corporations by cutting off necessary expenditures for research and technological development, the use of such funds for dividends, or to make a brave showing for the market manipulation of shares, is so great an offence against the general welfare that no self-respecting chemist should countenance it or endure participation in it.

Before anyone is admitted to the practice of medicine, it is required of him that he make a solemn oath to devote himself to human welfare. A solemn oath of allegiance to the principles of right is required of everyone who would practise at law. At present, chemists pass examinations—and look for a job. This does not accord with the great obligations of our profession. Therefore, as a possible means to secure a better status for the profession of chemistry in its own affairs, I venture to suggest that an Oath of Science be drawn and administered to everyone who would engage in chemical practice. He should bind himself on honour to seek diligently the truth by the right co-ordination of all facts, which alone leads to the truth, to abstain from all knavery under any and all conditions, and to address himself to the welfare of humanity, striving throughout his days to seek the

light of greater understanding and to bring about a larger, a better, and more abundant life for all mankind.

Two sources of enjoyment were provided for the morning of July 6. A large party accepted the invitation of the Clyde Navigation Trustees and made a tour of Clyde Harbour on board a boat specially placed at its disposal; and the other spent an enjoyable morning in the Picture House, Sauchiehall Street, where, among more frivolous pictures, they saw a film depicting the manufacture of rubber goods, kindly lent by the North British Rubber Co., Ltd., and a second, lent by Messrs. Chance and Hunt, Ltd., showing the mining of sulphur by the Texas Gulf Sulphur Co., U.S.A. A third film, relating to the manufacture of newsprint in Quebec, was unfortunately not available.

CHEMICAL ENGINEERING GROUP.

Among those to whom congratulations are due is the Committee of the Chemical Engineering Group for organising what proved to be the most successful conference which the Group has yet held. The subject discussed was Evaporation and Distillation and under this heading the following papers were read:—(1) "Observations on the Design of Ammoniacal-Liquor Stills," by Mr. P. Parrish; (2) "Tar Distillation," by Mr. W. A. Walsley; (3) "The General Problem of Evaporation," by Prof. J. W. Hinchley; and (4) "The Historical Development of the Distillation of Glycerin," by Mr. T. H. Gray. Mr. W. H. Coleman presided at the first session and Mr. J. Arthur Reavell, chairman of the Group, at the second. The discussions which followed the reading of the papers were bright and very useful to the technical men concerned; and the attendance throughout was extremely good. Abstracts of the papers are appended:—

Ammoniacal-Liquor Stills.

The present continuous columnar still for the distillation of gas liquor owes its origin to Savalle (1875), who was apparently intimately acquainted with the design and operation of the apparatus invented by A. Coffey in 1831 for producing in one operation a more concentrated spirit from alcoholic mashes. It is estimated that the quantity of gas liquor produced and distilled in the United Kingdom is approximately 1250 million gallons of 1.73 per cent. ammonia per year. The view is expressed that little advance has been made in the design of ammoniacal-liquor stills, largely because designers and manufacturers have concentrated their efforts on a circumscribed phase, viz., facility in removing the elements to admit of cleaning, and have to a large extent ignored, or overlooked, the question of operating costs and thermal efficiency, which are the major considerations.

The arrangements of gas-liquor stills are divided into three categories and the distinctive features of each are described and discussed. It is suggested that solutions of ammonia of such strengths as are typical of normal gas-liquor behave generally according to Henry's law. Gas laws, however, whilst allowing of a ready interpretation of the conditions obtaining in the still, do not afford all the fundamentals necessary to design, and the view is expressed that it is only by patient observation of details, such as can be obtained from practical working conditions, that an advance in the design of the elements constituting gas-liquor stills can be made possible.

Two diagrams dealing with the thermal aspect of gas-liquor stills, as affecting the manufacture of sulphate of ammonia, are furnished, and these give information on a phase of the subject concerning which singularly few data have hitherto been available.

The conditions governing the water balance of a saturator are then dealt with. This subject is of

interest owing to the introduction of washing processes for the production of neutral sulphate of ammonia.

Several graphs, plotted from experimental data, are given to show:—(a) Liquor and gas concentrations at two rates of feed with identical steam consumption; (b) efficiency of a gas-liquor still from the standpoint of steam consumption; (c) relationship between the composition of the liquor being distilled and the distillate leaving the still; and (d) intrinsic capacity of a still for dealing with gas liquor of varying concentrations.

The essential parts of a unit of plant for continuous distillation are described, and the following points, among others, are considered:—(a) Gas-liquor storage tanks; (b) preheaters and coolers; (c) Devil-liquor storage tank; (d) constituent parts of gas-liquor stills; (e) liming chambers; and (f) seal pots. Many interesting observations of considerable practical utility are made, including some relating to the starting and working of gas-liquor stills which should appeal to those who are responsible for their control and supervision.

Finally, an indication is given of the direction in which still design and arrangement are likely to advance. It is suggested that the present arrangement of plant does not allow of maximum conservation of the available heat, and that modification in this respect is essential. Designers must concentrate their efforts on the evolution of the elements of a still which admit of optimum bubbling of an attenuated character, together with maximum impact of the respective bubbles so formed. Time contact between liquor and vapour must also be ensured to promote rapid distillation. Optimum bubbling is a function of a definite vapour velocity which differs in each compartment of the still. Instead of the perforations or serrations of the elements being uniform in size, as at present, they must be varied to suit the varying volumes obtaining.

In the ensuing discussion Mr. Cooper expressed the opinion that a saving of more than 15 per cent. in the steam consumption of a still was not possible, and Dr. E. W. Smith discussed the effect of using an ammonia catch in reducing the cost of producing ammonium sulphate. Two forms of hoods were described by Mr. Ramsay Sibbald, who said he had used them to replace the serrated hood, which is sensitive to slope of the column. Professor Goodwin pointed out that depth of liquor on the trays had a certain bearing on the efficiency, and that the presence of oil would greatly influence the ultimate contact between the steam and gas. Mr. Byard urged the use of superheated steam, and described its uses in a Continental works. Mr. Coleman, the chairman, in thanking Mr. Parrish for his paper, observed that this was the first paper in which the application of scientific principles to the design of ammonia-liquor stills had been fully studied. He also described the Mallet type of dissociator. Mr. Parrish gave a detailed reply.

Tar Distillation.

Of the types of tar produced in gas-works' practice, that derived from coal carbonised in horizontal retorts is essentially a high-temperature tar, whilst tar produced in vertical retorts may be regarded as a mixture of low-temperature and high-temperature tars. Low-temperature tars are essentially paraffinoid and high-temperature tars benzenoid in character. The tar acids extracted from the oils obtained by distilling "horizontal" tar are mainly phenols and phenol homologues; those derived from "vertical" tar contain polyhydric phenols showing great affinity for oxygen.

The distillation of tar may be roughly divided into two parts:—(1) The primary or crude distillation, which consists in evaporating from the tar a

certain amount of its volatile matter, condensing this volatile matter and separating it into fractions, leaving behind in the still a residue of pitch of good merchantable quality; and (2) refining operations, under which are included all subsequent operations, such as the extraction and refining of tar acids, benzols, naphthas, etc.

The paper describes, with the aid of drawings, the lay-out of the Glasgow Corporation's Provan Chemical Works, and types of plant erected there for distilling tar and refining tar products. These works were designed with a view to obtaining a straight flow line through them, the waste materials travelling to one end and the finished materials to the other. The causticising portion of the carbolic-extraction plant is of interest in that the system is continuous. It comprises two Dorr reaction agitators and two Dorr thickeners, with Harding conical ball-mill, in which the lime is ground and slaked, and an Oliver continuous rotary filter for filtering the waste calcium carbonate sludge. There is also a Scott's evaporator for concentrating the caustic soda. The stripping of naphthas from light oils is carried out in two Wilton oil-topping plants, each of 10,000 gallons capacity per day. Three types of column are described in the paper, viz., the column packed with Lessing rings, the bubbler type of column, and the Kubierschky spraying column.

The paper also describes an experiment on the continuous distillation of vertical-retort tar, carried out in two Wilton dehydration coils, with a final steaming still. The tar in the first coil was maintained at 170° C. and at a pressure of about 30 lb. per sq. in. On releasing to atmospheric pressure, naphthas and water passed off as vapours to the condenser, and the residual tar was then pumped through the second coil, where the temperature and pressure were maintained at 360° C. and 24 lb. per sq. in., respectively. On reducing to atmospheric pressure, mixed carbolic and heavy oils passed away as vapours to the condenser, and the residual tar was steamed with superheated steam in the final superheating still. The experiments showed that tar could be distilled continuously with production of a good medium soft pitch of 120° F. twistpoint, even without the final steaming-still.

In the ordinary method of distillation, the tar yielded approximately 57 per cent. of oils and 43 per cent. of pitch. Under the conditions of the experiment, the yields were 73 per cent. of oils and 27 per cent. of pitch. The increased quantity of oils and the reduced quantity of pitch show that considerable cracking had taken place. The experiment, however, is not complete, as the oils produced have not yet been fully investigated.

Questions were asked by Messrs. Nichols and Mavis regarding details in connexion with the works, and in the discussion which followed Mr. MacLaurin made a strong plea for the adoption of a better nomenclature of high- and low-temperature tars, suggesting that these should be divided into five grades, namely, high-temperature tars, semi-high-temperature tars, medium-temperature tars, semi-low-temperature tars, and low-temperature tars. Mr. Parrish believed the time of contact between the flue gases and the stills in the new plant was too short and advocated the spiral instead of the vertical form of flues. He also expressed a wish that Mr. Walmsley would carry out tests on the different types of columns which had been installed at the works. The Wilton still was discussed by Messrs. Cooper and Potter, the last-named speaker giving a series of interesting figures illustrating the running of this type of plant. Mr. Coleman mentioned a series of experiments which he had carried out on pre-heaters, and suggested that a study of chimney losses would assist in economising in fuel.

The General Problem of Evaporation.

Evaporation in the technical sense is synonymous with vaporisation, which may take place under two distinct conditions, viz., at or below the boiling-point of the liquid evaporated. The study of the latter condition has occupied the attention of physicists, meteorologists, physiologists and others to an extraordinary extent for many years, but rarely has the work had any chemical-engineering aspect. Fifty years ago Stephan concluded that the rate of evaporation was proportional to the linear dimensions of the surface, and assumed that in still air it was strictly proportional to the difference between the vapour pressure of the liquid and the vapour pressure in the air; these conclusions, however, are of little use to the chemical engineer.

From a large number of experiments performed under laboratory and factory conditions, the rate of evaporation from a water surface is given by the formula

$$W = 26.2 \left(1 + \frac{v}{1.17} \right) \left(\frac{p_s - p_a}{P} \right)^{1.2}$$

where W is the weight of water evaporated in kg. per sq. metre per hour; v is the velocity of the current of air in metres per second; p_s is the vapour pressure of the liquid in mm. of mercury; p_a is the vapour pressure of the water vapour in air in the same units; and P is the barometric pressure. It is obvious that the formula should give satisfactory results with any solution, if the depression of the vapour pressure of the solution due to the presence of the salt be taken into account. As from a theoretical point of view the rate of evaporation in a still atmosphere should be proportional to the vapour-pressure differences, some explanation of the index is desirable. The explanation seems to be that absolutely still air is impossible under the conditions, for moist air is lighter than dry air, so that convection must be a normal accompaniment of evaporation. Again, when there is a difference of temperature between the liquid and the atmosphere, the convection effect is still more marked.

The above formula may be applied to drying operations as well as to evaporation from crystallising tanks and similar plant. Evaporation at the boiling-point brings forward a completely different set of conditions.

The rate of heat transmission in evaporating plant depends on the temperature drop and the temperature level; the velocities of the liquid and steam over the heating surfaces; the viscosity and density of the liquid; the resistance of the heating surfaces and any deposited scale; and the resistivity of the material of which the heating surfaces are made. There is little doubt that the rate of heat transmission is nearly proportional to the temperature-drop, but since mechanical disturbance takes place in some relation to temperature-drop and temperature-level and is limited by the design of the plant, no mathematical equation can be deduced except for a particular design. For any particular type of plant or at any particular temperature-level there is one temperature-drop at which the heat transmission will be a maximum.

All manufacturers know the value of "circulation" and the problem is approached by them in several ways. Mechanical circulation has been adopted with highly beneficial results; it is always found that an improvement in heat transmission results, if the circulation be improved by increasing the area of "down-comers," by altering the hydrostatic head, or by other means.

The presence of solid matter in the liquid to be evaporated is often beneficial in limiting the amount of scale-formation, but in nearly all cases the problem of scale-formation is a problem for the chemist as well as for the chemical engineer.

It will be realised that owing to the high latent heat of steam the cost of evaporating water is very high unless steps be taken to recover the heat dissipated in the steam. By using this steam in a second apparatus working at a lower temperature and pressure, and so on, one obtains the well-known system of "multiple evaporation."

Another method of recovering the latent heat of the evaporated steam has been brought to some practical success recently. By compressing the evaporated steam its temperature may be raised so that it can be used again as heating steam in the evaporator. This is equivalent to making the heating surface of the apparatus the condenser for the evaporated steam. Siemens tried this plan in 1868, but on account of the low efficiency of compressors in his day the experiment was a failure. A "heat pump" enables one to obtain by a single evaporating apparatus the same efficiency as is obtained with a triple- or quadruple-effect evaporator.

All those who contributed to the discussion, viz., Prof. Goodwin and Messrs. Parrish, Pooley, Malpass, and Alliot, considered that the paper offered considerable food for thought. The question of frothing was raised and several interesting suggestions were made regarding its prevention and elimination. Several speakers were of the opinion that the heat pump had to be viewed from a commercial as well as a scientific standpoint, and that it was not a sound economical proposition.

History of Glycerin Distillation.

Starting with a reference to Scheele's "sweet principle of fats" (1779), obtained by digesting lead oxide with olive oil, the author alluded briefly to Cap's process (1830-40), and also to that of Tilghmann (1850), who passed an emulsion of fat and steam through iron or copper pipes at 600° F. G. F. Wilson, of Price's Candle Co., made the first notable advance, in 1854, by actually distilling candle-works' "sweet liquor," using pre-heated copper stills of 10-30 cwt. capacity and air condensers. Although this process was economically wasteful, owing to the high temperature used, it persisted until the introduction of modern steam-heated vacuum stills.

After referring briefly to the patents of G. F. Wilson (1854), Wilson and Payne (1855) and E. T. Hughes (1859), the author described the process of F. J. O'Farrell (1881) as the next important advance. This inventor patented the use of vacuum and pump for distilling crude soap-lye in steam at 200° C. The extension of the use of glycerin for blasting and in the arts led to considerable activity in the design of apparatus and patents were issued to Clark (1881), G. Payno (1882), O'Farrell (1883), A. M. Clark (1884), and A. G. Brookes (1885); but the next notable advance was made by the Belgian Van Ruymbeke (1893), who patented the master idea of using a high-pressure steam coil for heating the still, thus dispensing completely with direct fire heat. This, together with the use of expanded re-heated steam for the actual distillation, obviated to a great extent the decomposition of the glycerin.

Scott's patent (No. 15,159 of 1899) constituted the next step forward, and the author described in detail a modification of the original plant which he had used, together with some results obtained in large-scale working. The plant patented by W. E. Garrigues in 1905 (No. 24,100) was next described and characterised as somewhat complicated, but economical in consumption of heat energy. Even more intricate and more economical was the plant of F. J. Wood, of which the main idea was to work from one to six stills with one jet of steam (E.P. No. 21,658 of 1907, and No. 24,920 of 1913).

The latest development in glycerin-distillation is contained in the patent of the Société Française

des Glycerines (No. 125,574 of 1919). The plant is designed to work without the use of free steam. Crude glycerin at 180° C. is passed in an atomised stato by means of suitable jets from one vessel to another vessel or still of higher vacuum. Steam coils maintain the temperature at about 180° C., and condensers and pump are used as required.

During the discussion, in which Prof. J. W. Hinchley and Messrs. Pooley, Parrish, and Hayhurst took part, several important points, such as purity of yield, entrainment of impurities, points where losses occur, use of oil as heating medium, etc., were raised. In replying Mr. Gray stated that as his records had been destroyed by fire, it was impossible to give actual figures.

Conversazione at the Royal Technical College.

The social functions of the annual meeting were fittingly terminated on Friday evening, July 7, by a conversazione held in the Royal Technical College by invitation of the Glasgow Section. Prof. Thomas Gray briefly welcomed the guests in the Hall, and in speaking of the prominent share taken by the Section in the doings of the Society reminded them that two former Presidents, Sir George Beilby and Prof. G. G. Henderson, were members of that Section. Notwithstanding the attractions of the dance, which commenced forthwith, a large proportion of the visitors made the tour of the building under the guidance of Student-Associates. There were two parties—one proceeded upwards to the fourth floor to attend the first experimental chemistry lecture and inspect the chemical laboratories, and then to descend to other parts of the building, whilst the other visited the mechanical engineering laboratory in the basement to witness machinery in motion, and then worked upwards so as to arrive at the fourth floor in time for the second experimental lecture.

There were exhibits in the following Departments:—Mechanical Engineering, Electrical Engineering, Library, Natural Philosophy, Pharmacy and Materia Medica, Botany and Bacteriology, Mining, Architecture and Building Construction, Metallurgy, Geology, Textile Manufacture, Chemistry and Technical Chemistry. The latter part of the evening was devoted to dancing and social intercourse.

Excursions.

No visit to Glasgow would be complete without a trip to the historic Loch Lomond, and so on Friday, July 7, a special train conveyed a very large party of members and ladies to Balloch, where they embarked on a steamer which took them to the head of Loch Lomond and back to Tarbet. Lunch and tea were served on board, and a stay was made at Tarbet to give the party an opportunity to walk over to Loch Long.

The Saturday was spent by 100 fortunate members at the Ardeer Works of Nobel Industries, Ltd.; the special train left Glasgow at 9 a.m. and returned at 5 p.m. The visit was both enjoyable and instructive, and we hope to give an adequate account of it in a future issue.

On Monday, July 10, there was an excursion to the Trossachs. The party went by train to Aberfoyle, and thence by coach to the Trossachs Hotel, where lunch was served. A walk of about one mile brought the party to Loch Katrine pier, where members embarked for Stronachlachar. At this place coaches were taken to Inversnaid on Loch Lomond, and the return journey was made by boat to Balloch, and by special train to Glasgow. The last day was spent in Edinburgh, where the Castle, the "Royal Mile" and other historic places were visited in the forenoon. Lunch was taken in the Caledonian Station Hotel, and in the afternoon the new chemical laboratories of the University were inspected by kind permission of Sir James Walker, and a visit was made to the Forth Bridge.

THE TRAINING OF THE CHEMICAL ENGINEER.

On June 28, Dr. R. F. Ruttan was welcomed to this country at a dinner given by the Committees of the Chemical Engineering Group and the Chemical Industry Club in the Prince's Room of the Hotel Cecil, London, and subsequently a meeting of the two organisations was held to hear his address on the training of the chemical engineer. Mr. J. Arthur Reavell presided over a very large attendance. As Dr. Ruttan's address will be printed in a later issue of this *Journal* it will suffice in this place merely to indicate the nature of its contents.

In a country like Canada, where ultimate success depended entirely upon the utilisation of vast natural resources, the type of man in greatest request was he who could adapt to prevailing conditions methods, principles and processes already known and well-tried elsewhere; such a man was the chemical engineer and one of the pressing problems was to provide an adequate supply of chemical engineers to meet both the present and the future demand. The chemist and the engineer had been called respectively the physician and the surgeon of industry, each playing his allotted task in promoting industrial science, but the claims of the general practitioner must not be overlooked; the chemical engineer must be able both to diagnose with the deftness of the physician and remedy with the assurance of the surgeon.

Attempts made in certain American and British universities to train the chemical engineer by providing the student with plant and demonstrating to him processes on a semi-large scale had not been successful, and in his opinion the best means was that initiated at the Massachusetts Institute of Technology, which consisted, briefly, in a 4-years' thorough grounding in the fundamental sciences, supplemented by a year's practical training in one or more specially selected and equipped stations. Such stations were situated near to large industrial centres and were provided with plant covering a wide field of technical operations; and each unit was directed by a fully qualified lecturer experienced in works' practice and provided with a technical library, together with a wealth of information available in the form of experience gained by specialists in working the various plants engaged in the industry.

Dr. E. F. Armstrong said that the scheme outlined by Dr. Ruttan was extremely interesting, but he had been taught from boyhood to doubt everything until he was convinced, and then to remain sceptical. The great difficulty lay in teaching the student two great subjects—chemistry and engineering—concurrently. Five years' training would be insufficient to produce a man who would be fit to enter a works. The type of man most wanted in chemical industry was one who, above all else, had a good knowledge of chemistry, whose knowledge was absolutely up-to-date, and who knew how to search the latest literature for matter he did not know. Provided the aspirant had been well grounded in chemistry and physics, those in the factory could teach him all that was necessary to make him an efficient works' chemist, particularly if he had a mechanical turn of mind.

Prof. F. G. Donnan said that the most important *desideratum* in chemical engineering was complete mastery over the all-important subject of physics. Industrial chemistry was almost entirely physics. As a professor he was inclined to agree with Dr. Armstrong that the universities were unable to turn out fully-qualified chemical engineers. It was impossible to erect full-sized plant in our universities, and useless to demonstrate with miniature plant.

Sir Robert Robertson thought that the American plan would be successful. At the beginning of the war there was a great dearth of men able to work and design plant, and although few were called upon to design, experience had shown how rapidly those who were well-trained in pure physics and chemistry were able to take control. One defect in the scheme was the omission of training in costing. Dr. Ellwood Hendrick expressed the opinion that the most important factor leading to success in chemical engineering was the possession of inborn curiosity and personal inclination, and he described how at the Pratt Institute, Brooklyn, U.S.A., under Dr. Allen Rogers, ordinary industrial workers had been successfully trained on lines which took advantage of those innate qualities to convert them into competent works' chemists. He hoped and anticipated that applied psychology would be called in to aid in the selection of the right type of man. Mr. J. McKillop suggested that no scheme of education was complete unless it included training that would qualify the chemical engineer to occupy the highest position in the works, viz., that of managing director; and after Dr. Schack-Sommer had given his views, Dr. Ruttan expressed agreement with Prof. Donnan's opinion that physics should be studied far more than it had been in the past; organic chemistry should be made more quantitative, and some of the time now devoted to making preparations should be given to the study of theoretical chemistry, and especially physical chemistry, a sound knowledge of which was of supreme importance to the chemical engineer.

THE CHEMICAL INDUSTRY CLUB.

A few weeks ago a meeting was held at the Chemical Industry Club which may have important results.

The Club has been established in its present premises for nearly three years and has grown steadily, not only in numbers, but also in its position relative to the general development of the profession and industry of chemistry in this country. The strong desire for greater unity among the manifold interests of chemistry, which has shown itself in so many ways since the commencement of the war, is as keen as ever, notwithstanding the difficult period through which all have been passing. This desirable end is not easy to attain. In addition to the social side, there are other, and perhaps more important, sides upon which it is desired to bring chemists and those interested in chemistry more closely into touch, and whilst this is recognised, it is being more and more strongly felt that the Chemical Industry Club can provide at any rate a common meeting place where the other questions can be freely discussed and from which, perhaps, they can be developed. It has naturally taken time for this feeling to grow, but that it has grown is now generally recognised.

Some time ago the Federal Council for Pure and Applied Chemistry recognised the Club as an important factor in the general organisation of chemistry by inviting one of its number to represent it officially upon the Council. It is well-known that the Federal Council represents all the different chemical interests, and is the only body of its kind in the country. Its object is unification of purpose and development. At one of its recent meetings it approved by resolution the general idea of developing the Club in the interests of the profession and, at the invitation of the Club, appointed seven of its members to attend a meeting with seven representatives of the Club to discuss the best means of extending its usefulness. It is this meeting which is referred to above.

The seven members of the Federal Council who were appointed were Sir William Pope, the chairman, Prof. H. E. Armstrong, Dr. F. E. Armstrong, Dr. Stephen Miall, Mr. W. J. U. Woolcock, Mr. E. V. Evans, and Prof. J. S. Phillip. The members of the Club, who were appointed by the Executive Committee, were Mr. A. G. Craig, the chairman, Dr. W. R. Ormandy, Dr. F. B. Dehn, Dr. A. Rule, Mr. T. Miller-Jones, Mr. W. Cullen, and Mr. H. E. Coley. These fourteen gentlemen, with the single exception of Mr. Woolcock, who was unfortunately prevented from being present by a previous appointment, dined together at the Club and after dinner discussed the subject in detail.

It is inadvisable to enter into the details of that discussion, which was very frank, for to do so would be to depart from the recognised principle laid down for all Club meetings, viz., not to give publicity to the views expressed. The Club has always endeavoured to promote frank expression of opinion, which is essential to its success. Consequently, what was said at this very interesting gathering, and a good deal was said, will be regarded merely as a necessary but confidential preliminary to the results obtained.

However, some facts and figures were given in order to enable those present to form their opinions, and these are of general interest. It was stated that the number of members standing on the books of the Club at that moment was 727. Of these 456 were town members, 244 country members, and 27 foreign members. Although such a membership was regarded as indicating very great progress, it was felt that there were many more who might and should join, and that the total did not represent all the support the profession and industry generally could give to the Club. It is, perhaps, understandable that in the early days of the Club some should have doubted its usefulness and were therefore not disposed to support it, but that feeling is practically eliminated, and now that the Club is receiving support from so many leaders of the profession, there is no reason why it should not increase very materially both its membership and its usefulness.

Financially the Club has been a success. It has paid its way without asking for a single donation or calling upon its guarantors for one penny. It has succeeded in accumulating sufficient funds to enable it to undertake necessary improvements, slowly, it is true, but surely. But it needs a little more support to enable it to provide some facilities which are perhaps not absolutely necessary but are certainly very desirable. At the present rate of subscription, which is very low (£3 3s. for town members, £2 2s. for country members, and £1 1s. for foreign members), each member contributes an average of about £2 14s. to the Club's income. The premises are sufficiently spacious to accommodate 1000 members, and an increase to this figure is one of the immediate objects in view.

Such a gain in membership would increase the income by about £700, and with this sum much could be done to increase the general efficiency of the Club. At the same time it must be remembered that the present facilities are not by any means limited to those seen and enjoyed in the Club premises proper at No. 2, Whitehall Court. The members have the use of another dining room across the corridor, an excellent lounge and drawing room, and bedroom accommodation.

It was made clear at the meeting referred to that the present Club could serve as the nucleus of a much more elaborate and imposing organisation, and so fulfil the dreams of many. But such growth would have to be steady and sure. The ambition was approved, but those who could claim the longest experience and the greatest influence in the profession advised, and rightly advised, a continuation of the steady work which was now proceeding,

and promised the weight of their influence in the effort. They thought that if the present policy of keeping the Club as chemically select as possible were continued, an increasing number of professional men would apply for membership.

And so, as the result of a very pleasant evening, it was decided to hold regular meetings of the representatives present, with the object of gradually building up the Club on sound lines in the interest of the profession and industry of chemistry generally. The fourteen members named above have undertaken, with the consent of the two organisations—the Federal Council and the Club—to work individually and collectively to make the Club better known and greatly to increase its influence in uniting the separate chemical interests of the country into a concrete and powerful whole.

STELLAR CHEMISTRY.

H. DINGLE.

The science of chemistry owes its origin and early development to the inspiration of one great idea. With a passion almost religious in its fervour, men consecrated their time, their thought, their energy—their whole lives, in short—to the search for the Philosopher's Stone. Universal transmutation was the goal of their ambition. We do not think much to-day of the Philosopher's Stone. We look upon it as chimerical, unworthy of the serious attention of scientific workers. Transmutation we know takes place; we have direct evidence of it; but the Philosopher's Stone—that is too much for our credulity.

And yet, if we take the trouble to examine the grounds on which we reject it, we shall find our justification not a very easy thing to establish after all. Shall we say the idea is too fantastic, somewhat too reminiscent of the Arabian Nights? It ill becomes us, in these days, to deny existence to the marvellous. Are not the Arabian Nights themselves made to look commonplace? Pioneers of aeronautics have given us a carpet as magical as any conceived by the Eastern mind. Centuries ago a Greek Aladdin rubbed a rod of amber, and the genius of the rod now lights our cities, warms our homes, carries us to the ends of the earth, and executes our enemies. No; it is not on these grounds that we can reject the Philosopher's Stone. Nor can we take refuge in the fundamental diversity of the chemical elements. That doctrine, from which the 19th century drew such nourishment, is barren for the 20th: the atom is no longer the ultimate particle of matter. We are forced, then, to the contention that there is no evidence for the existence of a Philosopher's Stone, that it diverges from the whole trend of modern thought, and that it is therefore intrinsically improbable. But can even this position be maintained? If we consider stellar spectra in relation to temperature, we find that the hotter the star the simpler the spectrum, until at the highest temperature we obtain practically nothing but the lines of hydrogen or helium. Is it, then, not reasonable to argue that in temperature we have the true Philosopher's Stone, converting all things—not, indeed, to gold, but to the infinitely more precious substance, hydrogen? Whatever may be said on this point—and we shall return to it later—there is no doubt that if a modern chemist devoted his attention to the production of extremely high temperatures, with a view to the transmutation of every element into hydrogen, he would be regarded, not as a fanatic, but as one engaged on a problem of the

utmost importance and pertinence. It would be strange indeed if chemistry, after abandoning the idea that retarded its progress for so long, were led by the onward march of progress back to that idea again.

Stellar chemistry has, indeed, a wonderful tale to tell. It was in 1859 that the researches of Kirchhoff and Bunsen, on the absorption of light by luminous gases and vapours, showed for the first time how the solar spectrum was to be interpreted. With that discovery a new era was opened in the annals of science, no less fundamental and infinitely farther reaching, both in space and in time, than the simultaneous announcement by Darwin of the doctrine of biological evolution. Everyone now knows how the twin sciences of astrochemistry and astrophysics arose. The spectra of terrestrial sources of light were, broadly speaking, of two kinds, depending on the physical state of the luminous body. A glowing solid or liquid gave rise to a bright continuous spectrum. An incandescent vapour produced a spectrum consisting of bright lines or bands on a dark background. The fact that the latter type of spectrum was characteristic of the chemical nature of its source suggested a means of analysis far more convenient than the standard reaction methods, and one which could be applied to substances at any distance from the experimenter so long as they were in the gaseous form and sent out sufficient light. The stars—and, in particular, the sun—were at temperatures incompatible with any condition but a gaseous one, and it would seem, therefore, that their composition could be determined. But there was a serious difficulty, in that the solar spectrum was of a kind quite unlike that of a luminous body on the earth. It consisted of a continuous spectrum, crossed by a large number of dark lines and bands. What was to be made of this? Kirchhoff and Bunsen solved the problem by showing that the dark lines were produced by absorption, and not by emission, of light. They found that if a glowing gas were placed in the path of a beam of light from a hotter source, giving a continuous spectrum, the gas would absorb from the beam just those "wave lengths," or spectrum lines, which by itself it would emit. The resulting spectrum would have a continuous background, crossed by dark lines in positions corresponding to the emission lines of the interposed gas, and would therefore serve the same purpose, so far as chemical analysis was concerned, as the emission spectrum of the gas.

The meaning of the solar spectrum was at once made clear. The sun consisted of a central mass giving a continuous spectrum, and an outer envelope of cooler vapours, whose chemical composition could be ascertained by comparing the dark lines of the solar spectrum with the emission lines of various substances produced terrestrially. It was not long before the spectra of other stars were obtained, and found, in the great majority of cases, to be absorption spectra of similar type, though not always showing the dark lines in the same positions. It appeared, therefore, that the constitution of the sun was typical of that of most of the members of our stellar system. Confirmation of this constitution was obtained by placing the slit of the spectroscopic tangentially to the sun, so that only the light of the outer portions was analysed. The spectrum obtained showed bright lines, most of which were identical in position with some of the dark lines in the ordinary solar spectrum.

Thus, almost at a bound, chemistry became a cosmical science. We are accustomed to this today, and it is perhaps a little difficult for us to realise what must have been the emotions of those before whose eyes the larger field was spread for the first time. Dynamics—which for so long had been the sole guide to cosmogony—now shared the honour

with chemistry. Indeed, chemistry took precedence, for whereas dynamics was practically confined to the solar system, chemistry could extend its labours into the whole of the visible universe. By far the most striking fact of stellar chemistry is the discovery that the universe throughout consists of practically the same elements as those with which we are familiar on the earth. The lines in stellar and nebular spectra which have not yet been identified are extremely few, and there is strong probability that their number will be still further reduced. Not only is this true of our own stellar system, but the spiral nebulae, which are believed by many astronomers to be distinct universes, also show lines which we can match in terrestrial laboratories. When we consider the enormous extent of space covered by modern observations, and the extreme diversity of the physical conditions existing in the different bodies examined, we cannot but realise that there must be some deep significance in this remarkable fact. Does it mean that the whole of the physical universe arose from a common origin? Or is it that Nature is restricted in her operations, so that she cannot produce material existences of a different type from those of which the earth is composed? At present we cannot decide between these alternatives.

It is not surprising that, in their early enthusiasm at the tremendous possibilities opened up by spectroscopic analysis, chemists should have entertained hopes which have not as yet, at any rate, been realised. Sober reflection shows us that the power of the spectroscopic is limited in more than one direction. The spectrum tells us nothing, for example, of the chemical composition of the greater bulk of the sun and stars; namely, the inner portions, which give rise to the continuous background of the spectra. We can only analyse the thin outer envelopes or atmospheres of these bodies. Nor can we even be sure that our information there is complete. The hypothetical element, coronium, for instance, is represented in the solar spectrum only by bright lines produced from the sun's corona during an eclipse. It gives no absorption lines, and if we had no moon to shut out the body of the sun's light, we might even now be ignorant of its existence. Who can say what substances present in the stars may be hidden from us in the same way? Again, we know now that there is a very large amount of dark matter in the universe. With regard to this, and to the composition of millions of faint stars which our large telescopes reveal to us, the spectroscopic is silent. Once it was hoped that a means might be found of analysing a substance through light reflected from its surface, and that in this way the planets could be brought to yield up the secret of their composition. But here also our hopes have met with disappointment, except in so far as absorption by planetary atmospheres has lifted the veil a very little. Even our nearest neighbour, the moon, is a complete stranger to us. The fact is that the spectroscopic, after bestowing its early affection on chemistry, has transferred its favours to physics. The later developments of spectroscopy have thrown no end of light on the physical characteristics and order of development of the stars. So intimate is our present knowledge of the processes taking place in a luminous body that it is probable that, even had the heavenly bodies yielded only unfamiliar spectrum lines corresponding to no known elements, we should still, in time, have been able to analyse the spectra and form ideas as to the evolution of the physical universe.

So far as chemistry is concerned, however, it is possible that the recent progress of astrophysics may throw some light on the order of the evolution of the elements. The study of a large number of stellar spectra has shown that the spectra can be arranged in a continuous sequence, in which the

transition throughout, from one end to the other, is perfectly gradual. The spectra of more than 99 per cent. of the stars examined are included in this sequence, and the few outstanding ones, though of great interest from a physical point of view, can be ignored for our present purpose. The temperatures of the stars whose spectra are thus classified are also found to be in regular order. Thus, denoting arbitrarily-made divisions of the succession by the letters B, A, F, G, K, M, we find that, from the B to the M stars, the temperature falls continuously. The characteristics of the various classes of spectra are as follows. In the very hottest stars—of which comparatively few exist, and which precede the sequence we have mentioned—we obtain bright lines of hydrogen and helium, together with evidence of an unknown substance. In the B stars hydrogen and helium are still predominant, but faint lines of other elements appear also. These are somewhat strengthened in the A stars, though the hydrogen lines still form by far the most conspicuous feature. The hydrogen lines are considerably less predominant in the F stars, and the metallic lines are much stronger. The G stars, *e.g.*, the sun, show the metals as conspicuously as they do hydrogen. The same tendency is continued in the K group, whilst in the M stars bands of compounds—particularly titanium oxide—make their appearance. We have thus a regular progression, with decreasing temperature, from a marked predominance of the lightest elements to a more or less uniform distribution of a variety of substances.

It is inevitably suggested by these facts that in the stars elements are being made or broken up. There is strong reason to believe that each star passes through the spectral sequence twice—first from M to B, and then back to M again. If, then, we are to take the spectra at their surface value, it would seem that in the upward stage the elements are being broken up into lighter ones, and that recombination takes place as the star descends the scale of temperature again. If this is so, a large amount of energy must be released during the building-up process, and we could account very satisfactorily for the maintenance of the heat of some of the stars, such as the sun, in spite of the enormous amount of energy they radiate continuously into space. The hypothesis has obvious attractions. But we must remember that the spectrum is not an infallible guide to the complete composition of its source. The fact that the spectrum of a star consists mainly of hydrogen does not necessarily mean that the star itself is so constituted. In this connexion a suggestion recently advanced by Dr. Saha, of Calcutta, is of very great interest.

The atom, as is well known, is now believed to consist of a central core of positive electricity, surrounded by an equivalent negative charge in the form of electrons, whose number varies from element to element. The core practically determines the atomic weight, whilst the chemical and spectral properties of the atom are due to the outer electrons. At high temperatures there is a tendency for an atom to become *ionised*, *i.e.*, to lose one of its electrons, by the vigour of its collisions with neighbouring atoms. When it does this its spectrum is considerably modified and the substance becomes, in fact, for spectroscopic purposes, a new element. At a still higher temperature another electron may become detached, and then virtually a third new element is produced, and so on. Now the successive spectra, due to the neutral, singly-ionised, doubly-ionised, etc. atoms, tend to lie farther and farther in the ultra-violet region as the amount of ionisation is increased. But, owing to the absorption of the shorter waves by the earth's atmosphere, we are unable to obtain solar and stellar spectra beyond a short distance in the ultra-

violet. Consequently, the spectrum of a star which appears to us to contain practically nothing but hydrogen, may actually contain lines, in the far ultra-violet, due to a large number of ionised substances of which we can obtain no knowledge. Hydrogen, however, is not affected in this way to anything like the same extent as the heavier elements, for, since it contains only one electron, it would, if it lost that, cease to be an element at all and would have no chemical or spectral properties. At very high temperatures, therefore, the visible spectrum of a mixture of substances would appear to be dominated by hydrogen. On this view the spectral evidence of the absence of a substance from a star is not to be accepted as final.

We are dealing here with problems of very great difficulty. The time has not yet come when decisive answers can be given to them. Nevertheless, the rate of progress during the last few years has been so rapid that it would be unwise to conclude too hastily that they are beyond solution. Chemistry has, at any rate, a new direction for its activities, and it is not improbable that in the stars it will find the answer to questions which, in the laboratories of earth, could hardly have arisen.

THE RECOVERY OF PRECIOUS METALS FROM PHOTOGRAPHIC AND OTHER TRADE-WASTE SOLUTIONS.

E. GARDNER.

Comparatively large quantities of silver, gold, and platinum are used in photography, glass-silvering and chemical gilding, electroplating and other industries, but relatively very small amounts are recovered from spent solutions owing to ignorance of simple and cheap methods of recovery. In the first three trades mentioned above, over 2 million ounces of silver nitrate, worth £200,000, is consumed yearly in Great Britain; of this amount more than three-quarters is used in photography and most of the silver content is lost irretrievably.

Photography.—The spent solutions produced by the photographer comprise toning-baths, fixing-baths, and various washing waters. Taking an average print on self-toning paper, about 85 per cent. of the silver originally present goes into the preliminary wash-water and fixing baths, 5–8 per cent., remains on the print, and the remainder passes away in the final washing.

Of the methods of recovery recommended in textbooks on photography, precipitation of silver from fixing-baths and wash waters by means of "liver of sulphur" does not produce a precipitate that settles well, and contamination with polysulphide, or any sulphides, is to be avoided where photographic materials are used. Precipitation of gold from toning-baths by ferrous sulphate is not satisfactory for cold and very dilute solutions, especially when thiocyanates are present; and there are much better reducing agents than ferrous oxalate for precipitating platinum.

The method recommended by the writer is to collect all solutions in a wooden vessel and to precipitate with clean scrap iron. Reduction is complete within 24 hours, heating is unnecessary, and the precipitate settles very satisfactorily. Two wooden casks should be used for continuous photographic work, one being used for charging and precipitating while the precipitate is settling in the other. The clear liquid is siphoned off.

At the yearly clean-up the precipitate is passed with water through a coarse sieve (6 holes to the linear inch) to separate undissolved iron, drained on a calico filter, washed with hot water, placed with the cloth in an enamel dish, and dried at a gentle heat. The precipitate should not be dried completely otherwise it may ignite spontaneously. It consists of impure metallic silver and possibly gold and platinum, and is technically termed "foots," an Anglo-Saxon word meaning the dregs or lees settling from a liquor. The operation of obtaining the precipitate may be called "footing."

The precious metals on paper cuttings, spoiled prints, etc. may be recovered by incinerating the material, if necessary after moistening with a solution of alkali nitrate, and adding it to the footing cask. Great care is required in burning celluloid films. Spoiled plates should be fixed, but negatives are not worth stripping. Batches of spoiled emulsion should be liquefied in warm water and treated with scrap iron in a separate cask, as they are very rich in silver. It is recommended that the collected precipitates be sent direct to a refinery; it is useless to send dilute solutions to a refinery as the freight on these will leave no margin of profit.

Glass-Silvering and Chemical Gilding.—In this, the next largest of the industries using gold and silver compounds, the bulk of the metal is retained on the article manufactured and the solutions used are to a large extent self-precipitating. All spent solutions and ashes are put into the foots barrel, as described above, and preferably with the addition of a little sodium chloride. The ashes will include those of sawdust, which is, or ought to be placed wherever solutions containing precious metals may drop or be spilt, as well as those of old polishing cloths, aprons and leathers. It should be noted that sawdust saturated with silver nitrate is very inflammable when dry. Handwash is collected in a separate vessel in which it is not necessary to use iron for precipitation, and settling can be facilitated by adding a very little lime. At the clean-up the rate of filtration can be accelerated by mixing some coarse sawdust with the precipitate. The whole is then dried, burned, and the ashes collected. Gold and silver stains on the hands can be readily removed with a very dilute solution of potassium cyanide, to which a few drops of hydrogen-peroxide solution have been added, and these washings can be put in the foots barrel. Finally, the foots barrel, after it has been in use for several years, should be burned and the ashes collected.

Gilding and Electroplating.—The electroplater has as a rule some knowledge of chemical manipulation and facilities for heating batches of liquor. For the recovery of precious metals from cyanide baths, many text-books recommend the addition of sufficient acid to decompose half the cyanide, and so precipitate the insoluble gold or silver cyanide. This method is to be condemned as very dangerous owing to the evolution of hydrogen cyanide. It is true that the recovery is fairly complete with silver, but the clear acid liquor has to be treated subsequently with scrap iron in the case of gold. Another method recommended is to evaporate the bath to dryness and to fuse the residue in a crucible; this is impracticable in many workshops. A more convenient method is to heat these solutions with zinc dust with frequent stirring, when a complete although slow precipitation is obtained. A very rough test to ascertain if precipitation is complete is to acidify a sample of liquid with hydrochloric acid; absence of precipitate indicates complete precipitation of the precious metals.

All neutral or slightly acid silver solutions, other than cyanide, should be acidified and precipitated as chloride. Desilverising acid or "stripping" solution must, if necessary, be diluted before pre-

cipitation, and the filtrate obtained must be neutralised or further diluted before passing to the drain. The precipitated chlorides may be drained and sent to the refiner, or reduced to metallic silver with scrap iron.

Solutions from platinum-plating, which often contain much phosphate, can be precipitated with zinc dust, but complete reduction is difficult. In some workshops electrolytic reduction, using an insoluble anode, is carried out and found satisfactory.

Filtration of Precipitates.—A few instructions on the making of square calico filters for these precipitates may be of use.

A square wooden frame is made of such size that its corners will just rest on the edge of the deep circular vessel into which it is proposed to filter. The frame may be, for example, 14 in. square and 3 in. deep and made of batten 1 in. thick, thus leaving an inner opening of 12 in. square.

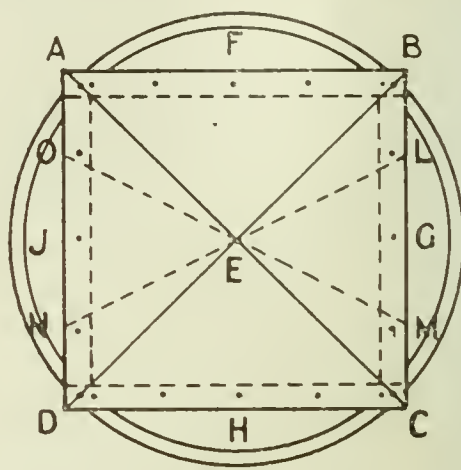


FIG. 1.

Top view of filter. Scale $\frac{1}{2}$.

From a piece of new, closely woven calico, washed to remove dressing and dried, cut an exact square of 24 in. side, mark the middle of each side and the middle of each upper edge of the frame, which may be conveniently standing on the circular vessel (Fig. 1). Taking the middle of each cloth-edge in turn, and doubling $\frac{1}{2}$ in. underneath to strengthen it, fasten it temporarily by means of copper tacks to the middle-points, F, G, H, J, of the upper edges of the frame, leaving the slack of the cloth hanging inside.

On the side AB, draw the cloth-edge tight from its central tack, double $\frac{1}{2}$ in. underneath as before, and fasten it with a tack almost at the corner B; repeat this with the other half of the same edge towards corner A. Turn the frame round and deal similarly with side CD. These two sides are now finished and are represented in the diagram of the unfolded cloth taken from the frame by the same letters (Fig. 2).

Taking side BC, hold the cloth-edge in one hand at a point B, (Fig. 2), 6.5 in. from the central tack, double $\frac{1}{2}$ in. underneath as before, slightly raise it from the frame, and with the other hand fold neatly along the line EP. Bring the point B, exactly down to the corner B of the frame and fasten it there with a tack; treat the similar points C, D, and A, in the same way.

The cloth ought now to form a perfectly regular inverted pyramid inside the frame, and if not, some slight adjustment must be made. Each side will consist of one layer of cloth, but underneath the

smaller triangles EBL, EMC, EDN, and EOA, in Fig. 1 there will be two extra layers. Drive the tacks home, add a few extra ones, and trim off the four ears of cloth which project beyond the frame (the triangles AA₁T, BB₁P, CC₁R, and DD₁S in Fig. 2).

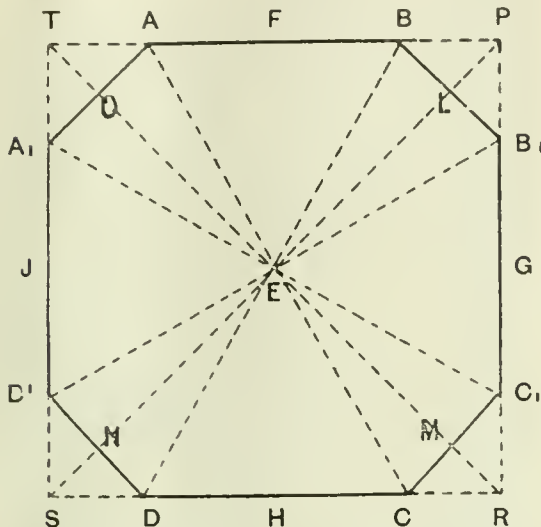


FIG. 2.

Filter cloth removed from frame, showing folds. Scale $\frac{1}{2}$.

The filter is now ready for use. Some boiling water is first passed through. Then a little precipitate is put in to form a filter bed, and as soon as the filtrate runs clear the filtration is proceeded with, care being taken that the filter does not run dry before all the precipitate is placed on the cloth. Finally, remove the soluble salts by washing a few times with hot water.

In packing precipitates before sending them to a refinery, care should be taken not to use metal boxes. A precipitate like moist silver chloride rapidly attacks iron or zinc, and foots powders often retain sufficient acid to corrode a metallic container. Well-made wooden boxes or jars of glass or earthenware should be used.

SAFEGUARDING OF INDUSTRIES ACT.

BORIC ACID.

On May 27, 30 and 31, Mr. Cyril Atkinson heard the complaint of the Chemical Merchants' and Users' National Vigilance Committee, represented by Mr. K. Swan and Mr. R. L. Parry, that boric acid had been improperly included in the list of articles dutiable under Part I. of the Act. The opponents, represented by Sir Arthur Colefax and the Hon. S. Cripps, were Howards and Sons, Ltd., H. Coghill and Son, Ltd. (Newcastle, Staffs.), G. H. Poole and Sons (Bootle), and Joseph Townsend, Ltd. (Glasgow). Mr. Whitehead represented the Board of Trade.

Mr. Swan, for the complainants, said that the boric acid imported into this country, mostly of 99.5 per cent. purity, came from the Larderello district of Tuscany, but the importation had ceased since the passing of the Act. The point at issue was whether this acid was a fine chemical or not; he held that it was not. Boric acid was used mainly

for the following technical purposes:—(1) For preserving butter and other foodstuffs; (2) in pharmacy; (3) in toilet preparations; (4) for glazing and enamelling pottery; (5) in the glass industry; (6) in metallurgy; (7) for leather manufacture; (8) in the soap industry; (9) for paper-making; (10) in the manufacture of candles; (11) for making borax; (12) as a ball-room floor polish. It was not normally, if at all, used as an analytical reagent; it had not been treated by the trade as a fine chemical, and was not manufactured by fine-chemical manufacturers. It was not generally dealt in or handled by dealers in fine chemicals, but was almost always sold by the producers or their agents direct to the consumer. It was obtained mainly from Tuscany, but also from natural borax by the simple processes of acidification and crystallisation.

Evidence was then given by representatives of four firms of chemical dealers, who stated that in their opinion boric acid was a heavy chemical; and various references in trade journals were adduced in support of this view. It was, however, elicited that in this country dealings in boric acid for the home trade were very rare and for relatively very small quantities.

Signor U. Funajoli, managing director and head of the electrical department of the Società Boracifera di Larderello, Florence, described the occurrence and extraction of boric acid from the natural springs and *soffioni* in Tuscany, and emphasised the simplicity of the process that was utilised in producing acid of 99.5 per cent. purity. He stated that during the war his firm exported about 80–90 tons a month to the United Kingdom, and that this trade existed before the war. About 10 per cent. of the boric acid exported consisted of 82 per cent. material, which was labelled "crude" and made by mixing the 99.5 per cent. acid with the lowest grade material of 55 per cent. purity. All the output was sold to Borax Consolidated, Ltd., and unless chemically pure boric acid was asked for no tests were made for the presence of lead and arsenic; if these were present they were eliminated by further crystallisation. His company's works were under the Government Mining Department and were not regarded as chemical works. Counsel for opponents elicited that since the Act was passed boric acid had been sent into this country invoiced as sassolite, a mineral containing about 80 per cent. of boric acid. Practically all the material exported from Italy was produced by his company. Before the war more crude acid than refined was exported; during the war the proportion of refined rose considerably, this product bringing in the greater profit; but recently increased labour costs had militated against the production of the refined material.

Mr. E. J. Parry agreed with the previous evidence, excepting the statement that arsenic and lead could be removed by crystallisation. The uses of boric acid in this country were distributed approximately as follows:—preservatives 60 per cent.; medicine and pharmacy 30 per cent.; other uses 10 per cent. Witness quoted a number of printed references to the classification of boric acid as a heavy chemical, and stated that in this Society's *Journal* abstracts concerning it were placed in Section VII., in which heavy chemicals were for the most part treated.

Sir A. Colefax said that his case was that boric acid was a fine chemical. No attempt had been made to describe how the Italian material was purified. As carried out in this country the manufacture was extremely difficult inasmuch as lead and arsenic had to be eliminated. As Mr. Parry had admitted, the B.P. quality was not sufficiently pure for preservative purposes. Imports from Italy were about 40 per cent. of the total importation, but only a fraction of the quantity manufactured here.

Mr. Alfred Howard, director of Howards and Sons, Ltd., said that his firm had been manufacturing boric acid for more than 40 years and that over 90 per cent. of the production, which was all of B.P. quality, was sold to wholesale druggists; the raw material used—boracite or colemanite—was purchased from Borax Consolidated, Ltd. Even if not of B.P. standard, he regarded boric acid as a fine chemical because it required much careful preparation. Similar evidence was given by Mr. H. Poole, whose firm manufactures boric acid for use as a food preservative. Mr. T. E. Lescher, director of Evans Sons, Lescher and Webb, Ltd., said that his company dealt in, but did not manufacture, boric acid—chemically pure, pure B.P., and commercially pure. The last-named was generally of B.P. quality, but the purity was not guaranteed. He regarded boric acid as a fine chemical because it was mainly used for medicinal and preservative purposes, and it had to be extremely pure. If such a chemical were used mainly for industrial purposes he would regard it as a heavy chemical, but he would still consider boric acid a fine chemical even if 50 per cent. of the production were used in industry.

Mr. B. D. Jones, secretary of Burton, Baker and Co., said that his firm used annually 300 tons of boric acid for food preservation, all of which was purchased from Borax Consolidated, Ltd., and Mr. F. Dickens, of Darton, Gibbs and Co., antiseptic surgical dressing manufacturers, stated that his company used 50 tons per annum. Mr. P. A. W. Self submitted results of analyses of commercial boric acid showing the high degree of purity of this grade, nearly all of which is apparently up to B.P. quality. On this account he held boric acid to be a fine chemical. If pharmaceutical chemicals and antiseptics were excluded from the list of fine chemicals, practically only analytical reagents would be left in it. Mr. F. A. Hocking, pharmacist to the London Hospital, stated that that Medical School consumed 2½ tons of boric acid yearly; and Mr. Edmund White, managing director of Hopkin and Williams, Ltd., expressed the view that boric acid was a typical fine chemical.

Mr. H. F. Johnson, sales manager to Borax Consolidated, Ltd., said that his company controlled many boric-acid manufacturing plants, partly through subsidiary companies and partly by working arrangements. About one-fifth of all the boric acid imported into this country came from Italy, which provided about 11 per cent. of the world's consumption. Of the boric acid consumed in the United Kingdom, 36·22 per cent. was used in medicine and surgery, 34 per cent. for food preservatives, and 6·78 per cent. for boric lint; but of borax, 82 per cent. was used for industrial purposes (pottery 25%, enamelling 14%, dyes 1%, glass 1·78%, metal industries 3·6%, paint and varnish 1·79%, and starch 10%). His firm controlled 85 per cent. of the sales of boric acid in this country, and all of it was up to the old B.P. standard. Much more of the acid manufactured here was used for pharmaceutical than for industrial purposes. A letter from the witness to the Larderello Co., written in October last, was then produced, in which he stated that the principal use was for industrial purposes, and that its importation should be free. The report of the directors of his company for 1921 was quoted to the effect that the medicinal uses of boric acid were ancillary to its industrial uses, and it was stated that the company had lodged a complaint with the Board of Trade asking that boric acid be removed from the list as it was in no sense a fine chemical. The witness explained that at that time he was importing boric acid, and that the complaint had been dispatched without proper consultation with his technical colleague, who had afterwards objected. Subsequently pressure was brought to bear

by the manufacturers in this country, and the complaint was withdrawn. The industrial uses of boric acid in this country were—pottery 3·7, enamelling 0·42, glass 3·65, and tannery 4·81 per cent. respectively of the total consumption. Of borax and boric acid combined about 60 per cent. was used for industrial purposes.

The process of manufacture in this country was then described *in camera* by Mr. H. Derring, works manager and chief chemist to Joseph Townsend and Co., Ltd., of Port Dunder, Glasgow. Dr. H. Bassett, professor of chemistry in University College, Reading, supported the view that the process conducted in this country was a fine-chemical process because its conduct involved continuous, skilled chemical supervision. In his view boric acid was a fine chemical because of the complexity of the process of manufacture; because the bulk of it was used for purposes which demanded very great purity, and most of these purposes were real chemical purposes, its uses in pharmacy and as an antiseptic being based on its chemical activity. His views on the general question of what is a fine chemical had been arrived at since the Act was passed, and he had followed with much interest the reports of the discussions which had been held by Sections of the Society of Chemical Industry. He did not think that references to trade catalogues threw much light upon the subject.

In his final speech Sir A. Colefax said that the complaint concerned only a fraction (one-fifth in 1920) of the boric acid consumed in this country. The object of the Act was to safeguard *home* industries, and over 80 per cent. of the consumption was made here by a process which differed entirely from the Italian process, and which required continual, skilled chemical supervision, i.e., supervision which was not confined to analytical tests, but which involved the application of the results of such tests. Whereas all the boric acid made here was of B.P. quality, the Italian product was not tested for lead and arsenic. The witness who had spoken about the Italian process had not described it but had only given some very inadequate details. The nature of the process used and the degree of purity of the product were very important considerations.

Mr. Swan objected that the Board of Trade had not called any witnesses to support the contentions advanced in its counter-statement. On the question of skilled supervision he said that it appeared from the opponents' statements that by increasing the number of chemists employed in a works and introducing new complications into the process any chemical could be brought within the category of fine chemicals. He held that there was practically a complete parallel between this case and that concerning tartaric and citric acids (*cf. J.*, 1922, 115 R). The use of boric acid for preserving food was regarded by the trade as a commercial use, and the substance had always been regarded by it as a heavy chemical. The evidence on that point remained uncontradicted, and there, he thought, the case should end.

The referee's decision, signed on June 20, ran as follows:—

I have said in previous cases that *prima facie* a substance is not dutiable on importation into this country and that it becomes dutiable under the Act in question only if there is no reasonable doubt about its being covered by the words in the schedule.

The complainants base their case against the inclusion of boric acid in the list of dutiable substances upon trade usage. They contend that there has been such a general classification or acceptance of boric acid as a heavy chemical as to make further consideration unnecessary and irrelevant. The evidence stands thus. Four chemical merchants of experience say that they have always regarded

boracic acid as a heavy chemical; three of them go further and say that it has always been treated and regarded in the trade as a heavy chemical. Mr. Parry said the same thing. Mr. Johnson, the sales manager of Borax Consolidated, controls and sells 85 per cent. of the boracic acid sold in this country. Surely he, if anyone, must be familiar with the trade view. Until a few weeks ago, before certain pressure was put upon him, his view was that boracic acid could in no sense be regarded as a fine chemical.

On the other hand, five or six witnesses were called who expressed the opinion that boracic acid was a fine chemical, but not one of them said that it had been so classified or treated by the trade.

The witnesses for the complainants are supported by the evidence to be derived from trade journals. It is, in my opinion, established that trade literature has consistently referred to boracic acid as a heavy chemical. I am not forgetting that it appears in lists of pharmaceutical chemicals, but that fact is almost colourless.

Further, the report issued by the Department of Overseas Trade on the market for heavy chemicals in the Argentine Republic deals with boracic acid as a heavy chemical.

I am satisfied and find as a fact that boracic acid has not been generally regarded as a fine chemical in the trade. The complainants further rely upon the following contentions:—

(a) That the scale of manufacture is undoubtedly large for a fine chemical. This was emphasised by Borax Consolidated in their abandoned complaint.

(b) That about one-fifth of the boracic acid consumed in this country comes from Italy and that whatever may be said of the difficulty of manufacture here the method of production there certainly does not tend to stamp boracic acid as a fine chemical.

Although criticised at a later stage, the evidence of Mr. Funajoli was not seriously challenged in cross-examination. It certainly satisfied me that the production in Italy is simple and does not require that skill and expert supervision which is usually associated with fine-chemical production.

Now, what is there to displace this strong *prima facie* case for establishing that boracic acid ought not to be included in the list as a fine chemical?

The Board of Trade put in a counter-statement prepared with its usual care and lucidity.

The ground relied upon as justifying the inclusion of boracic acid in the list is that 80 per cent. of the total consumption in this country is absorbed for medicinal and surgical purposes and that a considerable quantity is used for food preservation purposes and only insignificant amounts in the industries.

It is clear that the Board has been misinformed as to the facts.

I accept the evidence of Mr. Johnson that 43 per cent. is used for medicinal and surgical purposes, including lint, 34 per cent. for food purposes, and 23 per cent. for industrial purposes. Even these figures establish that over three-fourths of the consumption of boracic acid is for purposes requiring a high degree of purity.

At the hearing the opponents relied also upon the method of manufacture in England, contending that it required that skilled supervision which is one of the indications that the product is a fine chemical.

I cannot say that I am at all convinced by the evidence on this point. Dr. Bassett certainly said that the operations to prepare boracic acid were extremely complex and required very careful supervision, but when asked what part of the operation was complex he answered that one stage might reasonably be called complex, the stage where arsenic was removed. Now, curiously enough, Mr.

Derring, who actually supervises the manufacture, made light of that and said that the removal of arsenic was very simple.

On this point of difficulty I cannot forget the first complaint of Borax Consolidated. That complaint states that the method of production is one of the simplest operations and does not require chemical supervision. I cannot believe that steps such as the formulating and lodging of that complaint were taken without careful consideration. I asked Mr. Johnson if he had made the complaint on his own authority. His answer was "I did, and I did not." I do not know what that means, but he admitted that the managing director was consulted, and I do not believe that the statement did not represent the view of those responsible for it at the time. Having carefully considered the evidence given and bearing in mind the fact that difficulty of manufacture was not put forward by the Board of Trade in its statement and the attitude first taken up by Borax Consolidated, the conclusion I come to on the method of manufacture is that it does not help to weight the scales in favour of boracic acid being a fine chemical.

There remains, however, the very formidable point I have indicated, viz., the fact that three-fourths of the consumption is for medicinal and food purposes demanding considerable purity as a matter of vital importance. Ought this to outweigh the trade classification or usage? I think not. If I could persuade myself that the attainment of the necessary purity required the skilled labour and constant supervision by trained chemists demanded by fine-chemical production I might take a different view. Dr. Bassett put the matter admirably, but I am not persuaded as to the complexity of the operation. He has not seen it, and I repeat it is curious that the complexity he singles out should be described as simple by Mr. Derring. The complainants had no notice that the question of difficulty of production was to be raised. They came quite unprepared to deal with it. The opponents cannot therefore complain if the evidence they adduce is regarded somewhat critically.

On the whole I think that boracic acid is not a fine chemical within the Act, but whether I am right or wrong about that, I am quite satisfied that the position of boracic acid is at least so doubtful that it ought not to be included in the list of dutiable substances and I award that it be removed.

SCIENTIFIC GLASSWARE.

In this case, Jules Lang & Co., represented by Mr. K. Swan, complained of the inclusion in the list of reagent bottles, hydrometer jars, cylindrical measures and conical measures (bell-shaped). Mr. Courtney Terrell appeared for the Board of Trade. The complaint was heard on May 29 and the Referee's award is dated June 12.

Mr. Swan asked for a definition of the term "scientific glassware"; did the word "scientific" apply to the mode of manufacture or to the use? Certain bottles and stoppered jars which were used by confectioners, etc. closely resembled laboratory ware and the Customs were levying duty upon them, although they were not intended for scientific use. He suggested that the appellation "resistant" might suffice to distinguish between the two classes.

In giving evidence for the complainant company, Mr. E. J. Parry defined scientific glassware as glassware which resisted sudden changes of temperature and the action of chemicals, or which was used primarily for carrying out a scientific operation. All the articles mentioned in the complaint were scientific glassware excepting cylindrical and

bell-shaped glass measures, but reagent bottles must consist of resistant glass and museum jars must be made of very clear and resistant glass and be provided with air-tight stoppers. Mr. Bush, managing director of Henry W. Bush & Co., Ltd., said that his firm imported reagent bottles and sold them to dealers who supplied them to laboratories, and to pharmacists, etc. as "shop rounds." Bottles consigned to him had been held up by the Customs and he had been fined for not declaring them. His chief business was graduating cylindrical measures imported from America, Belgium and Sweden, and the degree of accuracy of the finished article was 3 to 4 per cent. Mr. F. Lang, proprietor of Jules Lang & Co., said that he had been fined by the Customs for importing, without declaring, stoppered cylinders which were not made for scientific purposes; and stoppered white glass bottles, invoiced as reagent bottles but not intended for use as such, had been treated similarly. His firm had started the manufacture of scientific glassware in 1918, but had since given it up.

Evidence for the Board of Trade was given by Mr. J. H. Gardiner, technical director of James Powell & Sons, Whitefriars, Ltd., who explained that his firm had separate departments for manufacturing domestic and scientific glassware, respectively, and that all the objects mentioned in the complaint were made by the scientific branch from special glass by processes requiring care, precision and accuracy. Mr. D. H. Baird, of Baird & Tatlock (London), Ltd., gave similar evidence. At the instigation of the Government he had started the manufacture of scientific glassware ("Duro" glass) during the war, but had sold that part of his business in 1920. The term "reagent" bottle connoted a specific quality of bottle. True reagent bottles could not be made in the same mould as ordinary bottles; they were practically lead-free, were resistant to the action of chemicals, and were provided with accurately-ground and numbered stoppers. Vendors of ordinary glass bottles did not use the term "reagent bottles." Sir Herbert Jackson said that he could not give a hard and fast definition of scientific glassware, but any glassware traditionally known as such, which had been made with great care, was of high quality and used for scientific purposes was scientific glassware. "Traditionally used for scientific purposes" was the essence of the description. All glass apparatus made for laboratory use, even for use in school laboratories, was scientific glassware. A reagent bottle must be made of clear glass, be accurately stoppered, be appropriately and properly annealed, and capable of withstanding changes of temperature. He would not specify freedom from lead, because some lead glasses were quite safe for laboratory use.

The following is the text of the award:—

In my opinion the question whether the descriptions complained of are properly included in the list of dutiable articles depends upon the meaning of the words used. I am satisfied that all the descriptions complained of are properly included in the list provided that these descriptions are used strictly and within the limits which are defined in this award. Reagent bottles are properly in the list provided that by the expression "reagent bottle" is meant a bottle which is reasonably fit for containing chemical reagents. The legal obligation implied on the sale of such bottles is that the bottle shall be reasonably fit for containing any ordinary chemical reagent, not fit for just a few but fit for any chemical reagent, except possibly some exceptional substance calling for special and exceptional qualities in its container. This obligation means that the bottle must be made of hard suitable glass free from lead. By "free" I mean containing no more than such a trace as does not matter. The

neck and stopper must be ground so as to make a perfectly air-tight joint. If a bottle does not fulfil these requirements it is not suitable for containing chemical reagents, and is not scientific glassware. I gather that the distinctive shapes of reagent bottles have been copied and that the description has been applied to inferior bottles and that these practices have led to trouble with the Customs. That trouble is not for me to deal with.

A hydrometer jar means a jar suitable for hydrometer tests. It is of distinctive type, straight sided, of circular or elliptical section and from six to ten inches high. The glass must be good and very clear. The jar must be a very good cylinder and must be capable of standing rapid changes of temperature.

Museum jars, specimen jars and surgical jars.—It is very possible that there is a practical difficulty in the case of these jars because the customary shape and description have been borrowed for all sorts of purposes which are not scientific and do not require scientific glassware. Any jar which is suitable for containing and displaying scientific specimens, not just a few specimens, but any scientific specimen not calling for exceptional treatment is a museum or specimen jar.

All three jars require the same qualities, i.e., they must have clear fronts so that there is no distortion caused by the glass. The edges must be ground very flat and true so that the glass plate laid on them will give an air-tight fit and prevent evaporation. The glass must be sufficiently well-made to prevent contamination of the liquid, if any, containing the specimen.

Cylindrical measures (bell-shaped) and conical measures.—I think that these measures are on the border line, and that the only articles of these descriptions which can properly be considered as scientific glassware are measures which are in fact graduated with scientific accuracy. It is the correct graduation which, according to the evidence, makes them scientific glassware. I award that the descriptions complained of are properly included in the list if and when defined within the limits I have laid down. The complaint therefore fails.

MEETINGS OF OTHER SOCIETIES.

SOCIETY OF GLASS TECHNOLOGY.

At the meeting held in Sheffield on June 21, Prof. W. E. S. Turner announced that the visit of the American Ceramic Society to this country, which was fixed for September of this year, had been postponed until 1923. It was decided to renew the invitation and to ask the Ceramic Society to join in the invitation and the arrangements for the meeting.

Mr. Y. Amenomiya, a Japanese member, contributed a paper on the devitrification caused upon the surface of sheet (window) glass by heat, in which he stated that he had found devitrification to take place at between 700° and 800° C. Mr. R. Kamita described an investigation on the influence of alumina in preventing the devitrification of sheet-glass during the drawing process. He showed that the temperature of devitrification of a standard glass increased with increasing amounts of alumina, and that 5 per cent. of alumina caused the devitrifying temperature to rise by approximately 100° C.

The swelling produced by adding water to sand was discussed by Mr. L. E. Morton, who pointed out that the subject was important as manufacturers still measured out batch materials instead of weighing them. From studies of three typical sands, he concluded that sand containing added water would more than fill a vessel which would contain the same sand when dry, the excess being as

much as 12 or 15 per cent. of the total dry sand. The three sands seemed to swell to a maximum extent when about 5 or 6 per cent. of water was added.

In a short paper on the mixing of batch, Prof. Turner compared the efficiency of hand-mixing with machine-mixing. In three samples from a batch mixed by hand the maximum variations were: sand 44—77 per cent.; lime 4.8—8.3 per cent.; whereas in a similar batch mixed mechanically the sand varied from 69 to 73 per cent. and the lime from 4.2 to 6.6 per cent. Machine-mixing, by giving a more regular batch, assisted melting and materially reduced the time required for producing good glass.

THE FARADAY SOCIETY.

A meeting was held in the rooms of the Chemical Society, Burlington House, on June 26. Five papers were read; a sixth paper, on the electrical conductivity of hydrochloric acid and potassium chloride in the presence of sucrose, being taken as read, as the author, Mr. A. J. Kioran, was absent.

Prof. A. W. Porter and Mr. J. J. Hedges presented a paper on the law of distribution of particles in colloidal suspensions, with special reference to Perrin's investigations. Perrin has shown that, when particles are distributed in a dilute colloid solution, the law of distribution is the same as that of the distribution of the molecules in an atmosphere; later, Burton showed that this law does not hold for any considerable distance from the surface, and in the present paper the authors attempt to ascertain the actual distribution from the surface downwards. In the experiments a dilute solution of gamboge was employed and the particles were counted by means of a modified form of ultra-microscope. The results found can be fitted fairly closely to a curve having the equation:—

$$\log_e \frac{n}{1 - bn} + \frac{1}{1 - bn} = Ky + A$$

where n is the number of particles per c.c., y is the depth, and b , K , and A are constants. Although b may be considered as representing the volume of a suspensoid particle plus the ocean of second phase surrounding it, and attached in some way to it, the authors consider it merely as an empirical constant.

A paper describing the electrochemical effects produced by superimposing alternating currents upon direct currents during electrolysis was read by Mr. W. R. Cooper, who classifies the effects according as the alternating current is smaller than, equal to, or greater than the direct current. In all three classes no great difference is found in the amount of copper deposited in an electrolytic cell when a low frequency alternating current is superimposed on the direct current, but an increase of current is obtained irrespective of the relative values. This effect does not pass off as soon as the alternating current is switched off, but dies down during a period which may last for several minutes. Microscopical examination of the electrodes during electrolysis showed the hydrogen bubbles clinging to the platinum electrodes and the oxygen bubbles escaping much more easily. The most interesting observation made with high-frequency alternations was when a very fine wire, just dipping into dilute acid, was used as one electrode, and a comparatively large piece of platinum foil as the other. Under certain conditions a large bubble formed in the electrolyte and travelled up to the electrode. This seemed to result from an audible discharge, which could be seen if the experiment were carried out in the dark.

Prof. T. M. Lowry and Prof. E. E. Walker read a paper on "The Expansion and Shrinkage during Caking of Potassium Carbonate." A sample of potassium carbonate, which had been kept in a paper bag for four or five years, was emptied into

an earthenware jar. Five days later it had fractured the jar, and continued to expand after the walls had fallen away. About this time the heat of the laboratory was shut off, and three weeks later the salt began to shrink, and eventually contracted to less than its original volume. Attempts were made to produce expansion in various modifications of potassium carbonate, but without success, though a possible explanation assumed the presence in the material of a sesquihydrate which expanded on conversion into the dihydrate.

In a paper entitled "The Powdering of Minerals by Decrepitation," Prof. T. M. Lowry and Mr. L. P. McHatton described the decrepitation of barytes by heat and attributed it to the presence of occluded water. A semi-quantitative relationship was found between the water content of the barytes and the fineness of the powder produced. Quantitative experiments were also described on the relationship between the loss of weight and the fineness of the powder produced by the decrepitation of celestine, croceite, and common salt.

The last paper was on "The Systems in which Metals Crystallise," by Dr. J. L. Haughton and Miss G. W. Ford. In most cases the system in which a metal crystallises depends on its position in the periodic table, and alloys that form a homogeneous series of solid solutions right across the diagram crystallise in the same system. There does not appear to be any relationship between the changes which occur in the physical properties of metals at the melting-point and their crystalline habit, with the possible exception of the resistivity of the metals in the odd series of Group 5.

PERSONALIA.

Sir William J. Pope has been appointed president of the International Union for Pure and Applied Chemistry.

Sir Humphrey Rolleston has been elected president of the Röntgen Society for the session 1922-23.

To Sir Dugald Clerk has been presented the Albert Medal of the Royal Society of Arts, in recognition of his important contributions to the development of the internal-combustion engine.

Dr. W. T. David, professor of engineering in the University College of South Wales, has been appointed to the chair of civil and mechanical engineering in the University of Leeds, in succession to Prof. Goodman.

Mr. D. A. Pritchard, until recently electrochemical superintendent to the United Alkali Co. in England, is now works manager of the Canadian Salt Co., Windsor, Ontario. Mr. W. Kynoch has been appointed superintendent of the Forests Products Laboratories, and Mr. R. E. Gilmore superintendent of the Fuel Testing Laboratories of the Canadian Department of Mines.

Dr. F. G. Cottrell, lately head of the division of chemistry and chemical technology of the National Research Council, U.S.A., has been appointed director of the Fixed Nitrogen Research Laboratory of the Department of Agriculture. Dr. R. C. Tolman, the present holder of this post, has been elected professor of physical chemistry and mathematical physics in the California Institute of Technology at Pasadena.

Other appointments announced in the United States are:—Dr. F. F. Renwick, director of the Redpath Laboratory of the E. I. du Pont de Nemours Co.; Prof. G. A. Hulett, professor of physical chemistry in Princeton University, a member of the United States Academy of Science; Prof. J. M. Bell, head of the chemistry department in the University of North Carolina.

Dr. Duparc, professor of chemistry in Geneva, has accepted the invitation of the Soviet Government to organise the Russian platinum industry; and Dr. H. von Euler-Chelpin, professor of chemistry in the Stockholm "Högskola," has been appointed to a professorship in the University of Vienna, as from January 1, 1923.

Prof. A. Sieverts, of Greifswald, has been called to the chair of inorganic chemistry in the University of Frankfurt. Dr. Neuberg, director of the Kaiser-Wilhelm Biochemical Institute, has been elected ordinary professor in the Berlin Agricultural "Hochschule." Prof. P. P. von Weimarn has been appointed to the Imperial Institute for Technical Research, Osaka, Japan, where he will equip a laboratory for research in colloid chemistry.

* * *

The deaths are announced of Jules Domergue, director of the Syndicat des Fabricants de Sucre de France since 1887; Thomas Gutler, who founded the beet-sugar industry in Utah and Idaho, U.S.A., aged 78 years; and Johann Pokorny, the sugar technologist, of Prague, at the age of 72 years.

Prof. Otto Lehmann, the discoverer of liquid crystals, and professor of physics in the Technical "Hochschule" of Karlsruhe since 1889, died on June 20 at the age of 67 years. Other deaths announced from Germany are:—Dr. F. Voigtländer, honorary professor in the University of Hamburg and director of the department of applied chemistry in the Research Office, Hamburg, aged 60 years; and Dr. A. von Wacker, director and co-founder of the Dr. A. Wacker Gesellschaft für Elektrochemische Industrie.

NEWS AND NOTES.

UNITED STATES.

Reported Disintegration of Tungsten.—In a letter published in a recent issue of *Chemical and Metallurgical Engineering*, Dr. G. L. Wendt replies to criticisms of the work by himself and C. E. Irion on the atomic disintegration of tungsten (*cf. J.*, 1922, 131 n). Dr. Wendt states that the only spectrum unmistakably shown by the gases produced by the high-temperature explosion was that of helium. The background showed what seemed to be the banded spectrum of nitrogen, and the faint evidence of the strongest green line of mercury was possibly due to the backward diffusion of mercury vapour from the exhaust pump. An average of slightly more than 1 c.c. of gas was produced by exploding 0.0005 mg. of wire, and as the gas would correspond, if it is all helium, to nearly one-half the material of the wire, this should exclude the possibility that gases were adsorbed or occluded. The fact that no hydrogen lines were observed is of interest because the atomic weight of tungsten is an exact multiple of that of helium; and also because Sir E. Rutherford (*Phil. Mag.*, 42, p. 809) produced hydrogen in small quantities from elements (B, N, F, Na, P) whose atomic weights were not multiples of four, but not from elements with atomic weights that are multiples of the atomic weight of helium. An account of the work is to appear in the *Journal of the American Chemical Society*.

Recent Research Work on Fertilisers.—Among the papers read before the Division of Fertiliser Chemistry at the Spring Meeting of the American Chemical Society was one on the fertilising value of sulphur by Mr. L. S. Bushnell, who quoted the results of experiments to show that increased yields of from 50 to 1000 per cent. have been obtained by using sulphur with alfalfa and other

leguminous crops; that soils cultivated for several years contain relatively less sulphur than corresponding virgin soils; and that the fertilising value of ammonium sulphate and acid phosphate is sometimes due to their sulphur content and not to that of nitrogen or phosphorus.

Messrs. W. H. Waggaman and H. W. Easterwood described experiments on the applicability of the furnace process for producing phosphoric acid to run-of-mine phosphate. Much waste phosphate material, sufficiently rich in clay, can be briquetted after grinding to pass a 10-mesh sieve. Two methods of incorporating the necessary water were described, an average of 10 per cent. of water being found satisfactory when the briquettes were made under a pressure of 2500 lb. per sq. inch. The possibility of using coal as a reducing agent in making such briquettes was favourably regarded, and it was stated that furnace tests were to be made to determine the applicability of the furnace process of producing phosphoric acid to the Florida and Tennessee phosphates.

Cyanamide used in certain fertiliser mixtures was stated by Mr. W. S. Landis to be rapidly converted into urea or other salts, but not into dicyanodiamide; when dicyanodiamide was intentionally added to them it disappeared on mixing.

The fertilising value of wool-scouring wastes was discussed by Dr. F. P. Veitch, who observed that the annual loss of this waste amounted to over 60,000 tons of fertiliser material containing the equivalent of 96,000 t. of kainit and 3600 t. of tankage. The 267,857 t. of unscoured wool used annually in the United States contains an average, for all grades, of 4 per cent. of potash (K_2O), 0.5 per cent. of nitrogen, and 15 per cent. of grease, both nitrogen and potash being water-soluble. "Base goods" containing 6 per cent. of water-soluble potash and 6 per cent. of nitrogen, and in excellent mechanical condition for application to the soil, have been prepared from concentrated wool-scouring wastes, and it is hoped that this important source of fertilising material will soon be available in large quantities.

AUSTRALIA.

Carbide Manufacture in Tasmania.—The Hydro-Electric Power and Metallurgical Co., which has recently changed its name to the "Carbide and Electro-Products, Ltd.," has decided to increase its power consumption from 3500 to 5000 electrical h.p., so that the annual output of its carbide factory at Electrona, Hobart, will probably be raised by at least 1000 tons. In the interest of economy crude limestone from the company's quarry at Nor'-West Bay is to be burnt on the spot instead of at the carbide factory.—(*Ind. Austr.*, Apr. 27, 1922.)

Pottery Clay from Victoria.—An account of the examination of a sample of white clay from a deposit near Bendigo, in the State of Victoria, is given in a recent issue of the *Bulletin of the Imperial Institute* (XIX, 4, 1921). The clay contained about 4 per cent. of gritty matter, which had to be removed by washing, and analysis of the washed material indicated that the content of alumina was too low, and that of other metallic oxides and silica too high for the sample to be regarded as a china-clay of first-class quality. After washing, the clay would be suitable for making white permeable pottery, which can be glazed to yield a fine white earthenware. It is unsuitable for making hard porcelain, but could probably be used in conjunction with suitable felspathic and siliceous materials for producing "semi-porcelain" or impermeable stoneware. The washed clay could be mixed with grog for making second-grade refractory bricks.

FRANCE.

Industrial Notes.—Chemical Industry.—According to the German Press the agreement that is reported to have been made between the German dyo trust and the Compagnie Nationale des Matières Colorantes et de Produits Chimiques and the negotiations between the German dye trust and the British Dyestuffs Corporation are the prelude to a vast international chemical combine to include Germany, France, Great Britain and Italy.

There is a notable improvement in the demand for chemicals, especially for products such as acetic anhydride, acetone, etc. used in making non-inflammable acetyl-cellulose films. Various improvements have been made in the methods of manufacturing cellulose products; thus the "cellophane" made by the Thaou-les-Vosges chemical factory is finding increasing use and a firm in Lyon is producing a new acetyl-cellulose silk which is claimed to be as strong and flexible as natural silk but more lustrous. The small demand for coal-tar products has led to a decline in prices, the quotation for benzene having fallen from 150 to 120–125 francs per 100 kg. and for toluene from 210–215 fr. to 190–200 fr. per 100 kg. Prices of paint products and mineral solvents, however, are tending upwards, and carbon tetrachloride now stands 20 fr. higher at 240 fr. per kg. It is expected that the price of the zinc oxide will fall as the large new factory of the Société Française du Zinc at the Etang de Berre is now in operation. The fertiliser season is now over and orders for nitrate are not expected until the autumn. High prices, due to the heavy cost of transport, labour and sulphuric acid have greatly reduced the demand for superphosphate; thus the French consumption has declined from 1,200,000 metric t. in 1914, to only 660,000 t. in 1921, and the European consumption has fallen from 5 million t. in 1913 to 2 million t. in 1921. Despite the new reduction in the price of alcohol, the demand has not revived and stocks are growing rapidly; State control is proving as great a hindrance to the alcohol industry as it has to that of tobacco. The price per hectolitre of alcohol used in making products for the home market is 250 fr. and in making products for export 180 to 200 fr., so that manufacturers of drugs and perfumes find difficulty in competing in the foreign market as there is no margin for reducing costs.

GENERAL.

A Green Photographic Sensitiser.—The assistance which photography can render the scientific investigator has hitherto been somewhat limited by reason of the fact that quantitative measurements of the distribution of energy, even throughout the visible spectrum, have been vitiated by the well-known selective sensitiveness of photographic gelatino-bromide emulsions. The greatest deficiency of sensitiveness, and moreover that which has most effectively withstood all efforts to remove it, occurs in the green and greenish-yellow portions of the spectrum. The announcement of the discovery of a new green sensitiser by Dr. W. H. Mills and Sir W. J. Pope in the May issue of the *Journal of the Chemical Society* will therefore be welcomed as a step towards the realisation of a truly panchromatic sensitive emulsion. The compound, of which the "bathing" action is claimed to impart a uniform sensitiveness extending almost to the D line, is 2, *p*-dimethylaminostyrylpyridino methiodide, and results from the condensation of α -picoline methiodide with dimethylaminobenzaldehyde in alcoholic solution, in the presence of piperidine, by boiling for 5 hours. Recrystallised from methyl alcohol, it appears as bright red prisms exhibiting a blue reflex and melting at 275° C. A 1:30,000 to 1:40,000 aqueous solution constitutes the sensitising bath.

This is the first green sensitiser of which the constitution has been published; if its use does not lead to the formation of fog—an all too evident tendency of sensitising dyes—and if it can be successfully applied in conjunction with the known red sensitisers, the science of photography, as well as the science which is anxious to employ photography more and more as its unbiased "eye," will be immensely richer for the discovery.

Hops.—A series of papers published by A. Amos in the *Journal of the Ministry of Agriculture* contains some very useful information on the cultivation of hops. The importance of adequate manuring is emphasised and schemes of typical manuring are given. The fourth paper (in the April issue) on commercial varieties of hops is of much interest to the brewer. The good and poor qualities of each variety are discussed. One of them (Tollhurst), which is evidently a favourite in some districts on account of its good cropping power, is of indifferent quality from the brewer's point of view, and its cultivation is to be discouraged.

Research in the Brewing Industry.—The research scheme of the Institute of Brewing is under the control of a representative committee of brewery directors, brewers, and agricultural and brewing scientists. There is no director of research, but special sub-committees deal with various aspects of the work in hand. Problems relating to the raw material of the fermentation industry are being investigated on sound scientific lines.

The latest report on the progress of the scheme has recently been issued by the Institute. The work of Mr. E. S. Salmon on the raising of new varieties of hops is described, and tests from the standpoint of yield, disease-resistance and brewing qualities of the hops are showing valuable results. The "nettlehead" disease, which has caused the loss of many promising varieties, is about to be investigated by Prof. V. H. Blackman; and manual experiments have also been carried through. The drying of hops is receiving attention. A description with illustrations is given of an experimental oast designed by Mr. A. H. Burgess. The oast is not intended to be a model commercial plant, but is constructed to keep the various factors concerned in the process of drying under strict control. Prof. F. L. Pyman is continuing the difficult chemical investigation of the constituents of the hop upon which the preservative qualities depend.

The tainting of the beer stored in casks made of American oak seems to be caused by something extracted from the wood by the beer. Prof. Groom reports that micro-organisms appear to play no direct part in it, nor does the trouble lie in an unsuitable method of cutting the staves and end pieces. The possibility that there is some indirect relationship between the amount of starch in the oak and its suitability for cask-making is suggested and discussed. The time of felling the trees may also be of importance, and the help of the U.S. Forest Service in settling this point is being invited (*cf.* J., 1921, 32 R, 256 R, 370 R; 1922, 193 R).

The Ceramic Industry in China.—The Chinese ceramic industry has made little progress, despite its 2000 years of existence, and primitive kilns and methods are still used. Both the Government and the province of Kiangsi support a ceramic laboratory, but apparently no attempt has been made to develop production on a large scale. Nevertheless, the exports of ceramic products greatly exceed the imports; in 1920, 16,402 short tons was exported and 13,027 t. imported. The chief centres of the porcelain industry are at King Teh Chen, south of Kiukiang, To Hua, near Hing Wah, and Shekwan, near Canton. Important deposits of high-grade

kaolin are found in several localities but none is situated conveniently for supplying foreign markets; probably better situated deposits could be found. There are several undeveloped deposits in the province of Fukien, but the most promising is situated in the province of Kwantung, where there is no local industry but abundant labour.—(*U.S. Com. Rep.*, Apr. 10, 1922.)

Exports of Minerals from Tunis.—The quantities of minerals exported from Tunis in 1921 as compared with 1913 (shown in parentheses) were as follows:—Phosphates, natural, 1,455,239 metric tons (1,984,000 t.); iron ore, 204,012 t. (594,200 t.); lead ore, 5997 t. (59,446 t.); zinc ore, 7812 t. (30,627 t.). Official statistics do not record an export of lead metal in 1913, but in 1921, 15,230 t. was shipped. Of the phosphate exported in 1921, France took 576,277 t., Italy 522,012 t., Great Britain 84,377 t., and Belgium 72,565 t. The iron ore went chiefly to Great Britain, Germany and France, the lead to Spain and France, and the zinc ore to Belgium and France.—(*U.S. Com. Rep.*, May 8, 1922.)

Lead and Zinc in 1921.—The Imperial Mineral Resources Bureau has compiled the following advance statistics showing the world's production, imports and exports, of lead and zinc during 1921:—

LEAD.		1921	
		Long tons.	
United Kingdom	Imports ..	Pig and sheet ..	132,602
	Exports ..	Pig lead ..	11,008
Northern Rhodesia	Production	Lead ..	17,686
	Exports ..	Pig lead ..	18,348
Union of South Africa	Production	Ore ..	189
	Imports ..	Pig and sheet ..	362
	Exports ..	Ore ..	4
South W. Africa Protectorate	Production	Copper and lead ore ..	72,643
	Exports ..	Raw lead ..	198
Canada ..	Production	Refined lead ..	25,732
	Imports ..	Bars, sheets, pig and block ..	492
	Exports ..	Pig lead and lead contained in ore ..	13,408
Burma ..	Production	Lead ..	25,000
India ..	Imports ..	Lead ore ..	102
	Exports ..	Pig lead ..	311
	Exports ..	Pig lead ..	30,624
Australia ..	Production	Lead contained in ore and concentrates ..	83,978
		Refined metal produced in Australia, and metal in bullion and in ore and concentrates exported ..	62,777
	Exports ..	Pig lead and lead bullion in concentrates and ores ..	33,749
		Lead ..	6,448
Belgium ..	Imports ..	Lead ..	16,384
	Exports ..	Lead ..	25,133
France ..	Imports ..	Ore ..	13,773
		Pig lead, argentiferous and non-argentiferous ..	33,043
	Exports ..	Ore ..	3,685
		Pig lead, argentiferous and non-argentiferous ..	8,017
Germany ..	Production	Lead ..	65,000
Italy ..	Production	Lead ore and argentiferous lead ore ..	26,100
		Lead ..	11,300
Norway ..	Imports ..	Crude lead ..	124
Russia ..	Production	Lead-zinc ore ..	3,710
Spain ..	Production	Lead ..	100,000
Algeria ..	Exports ..	Ore ..	11,237
Tunis ..	Exports ..	Ore ..	5,901
		Metal ..	14,985
Mexico ..	Exports ..	Metal ..	59,541
United States ..	Production	Primary domestic lead ..	170,000
		Soft lead ..	129,500
		Desilverised soft lead ..	49,000
		Refined lead from domestic ores ..	348,500
		Smelted and refined from foreign ore and bullion ..	44,500
		Total lead smelted or refined ..	393,000
		Antimonial lead ..	7,100
Imports ..		Lead content of ore and bullion ..	38,378
		Pig, bar and old ..	27,018
Exports ..		Pig and bar ..	23,515

ZINC.		1921.	
		Long tons.	
United Kingdom	Production	Spelter ..	10,000
	Imports ..	" ..	72,486
	Exports ..	Crude and manufactured	7,424
Northern Rhodesia	Production	Ore ..	20
Union of South Africa	Imports ..	Unmanufactured zinc ..	1,372
Canada ..	Production	Smelter production ..	23,703
	Imports ..	Spelter ..	496
	Exports ..	Ore ..	46
		Spelter ..	11,454
India ..	Imports ..	Spelter ..	3,100
	Exports ..	Zinc or spelter of all kinds	4,000
Australia ..	Production	In lead and zinc concentrates ..	139,460
		Refined metal produced in Australia, and metal in ore and concentrates exported ..	21,297
	Exports ..	Spelter and zinc in concentrates and ores ..	1,043
		Spelter ..	19,616
Belgium ..	Production	Ore ..	65,402
	Imports ..	Ore ..	186,057
	Exports ..	Spelter ..	37,581
France ..	Imports ..	Ore ..	40,717
		Crude zinc ..	11,190
	Exports ..	Ore ..	8,154
		Crude zinc ..	4,829
Germany ..	Production	Spelter ..	120,000
Italy ..		Ore ..	68,000
		Spelter ..	370
Netherlands ..		Spelter ..	3,000
Norway ..		Spelter ..	12,000
	Imports ..	" ..	6,955
	Exports ..	" ..	16,930
Poland ..	Production	Spelter ..	5,000
Sweden ..	Production	Spelter ..	6,000
Algeria ..	Exports ..	Ore ..	17,255
Tunis ..	Exports ..	Ore ..	7,686
United States ..	Production	Primary metallic zinc—	
		From domestic ores ..	173,200
		" foreign ..	2,200
		Re-distilled secondary zinc ..	175,400
		Total of distilled electrolytic zinc ..	190,600
	Imports ..	Ore ..	6,731
		Lead content of ore ..	2,415
		Blocks, pigs and old ..	6,017
	Exports ..	Pigs, slabs, etc. ..	2,136
Japan ..	Production	Spelter ..	7,000

New German Committee for the Standardisation of Non-Ferrous Metals.—The standardisation of metals and metallic alloys in Germany has hitherto been entrusted to a sub-committee of the standardisation committee for German industry as a whole, but it has now been decided to form an independent organisation to be known as the "Fachnormenausschuss für Nicht-Eisen-Metalle" (Berlin N.W. 7, Sommerstrasse 4a). The expenses of the new committee will be paid by contributions from producers and consumers. The working committees on copper and copper alloys, aluminium and its alloys, lead, tin and its alloys, low-tension cables, etc. will not be affected, but a new working committee has been formed to deal with commercial analyses of non-ferrous metals.—(*Metall u. Erz*, May 8, 1922.)

Potash Production in the Far East.—Japan is the only Far-Eastern country that produces potash in quantity, although most Asiatic countries possess potential supplies in the form of seaweed. Thus the ash of seaweed found abundantly on the Coast of the Philippine Islands contains about 45 per cent. of potash, but it has not yet been utilised industrially. Three or four companies are engaged in the potash industry in Japan, and in 1920 they exported 1143 tons of potassium chloride in addition to 834 t. of potassium carbonate, which was shipped to the United States. The industry is worked on a small scale in China, chiefly in Kwantung province, Canton being the exporting centre; potash worth 40,000 to 50,000 taels (tael=roughly 3s. 7d.) is exported annually, mainly to Hongkong. Small quantities of potash are also exported from the Dutch East Indies and from the Straits Settlements.—(*Ch. of Comm. J.*, May 19, 1922.)

New Commission for the Perfumery Industry in Italy.—By a decree dated March 30 the Italian Ministry of Industry has appointed a commission composed of representatives of the Ministry and of the floricultural and perfumery industries to report on means for improving those industries.—(*G. Chim. Ind. ed App., May, 1922.*)

Production of Gums in the Red-Sea District.—In order of importance, the principal gums produced in the Red-Sea district are gum myrrh, from Abyssinia and Arabia, gum arabic, from Somaliland and Mokalla, and gum frankincense, from Somaliland, the Yemen, and the island of Socotra. Gum myrrh from Abyssinia is considered the best, but gums from the interior of Africa have to be cleaned and prepared for the export trade at Aden. Exports of these gums, almost entirely from Aden, were as follows in 1920 and 1921:—

	1920.	1921.
	Long tons.	
Gum myrrh	1057.5	578.6
Gum arabic	509	271.7
Gum frankincense ..	1440.4	766.1

The production of gums in Arabia has declined owing to internal unrest.—(*U.S. Com. Rep., May 8, 1922.*)

PARLIAMENTARY NEWS.

Imports of Glassware.

Answering Mr. Gilbert, Sir W. Mitchell-Thomson gave the quantity and value of the glassware imported from Germany during the year ended March 31, 1922, as follows:—Domestic and fancy glassware, including cooking utensils, table and ornamental glassware, 2718.7 tons, £105,375; illuminating glassware, globes and shades (other than oil-lamp chimneys), 1990.2 t., £73,103; other illuminating glassware (other than oil-lamp chimneys, electric-lamp bulbs and miner's lamp glasses), 21.5 t., £852.—(June 26.)

Fuel Oil.

Mr. Bridgeman informed Mr. L. Malone that the Anglo-Persian Oil Company's refinery at Ilford, Swansea, would be used for treating crude petroleum only. The Government did not interfere in the company's commercial activities and the use of the refinery for treating oil produced by the destructive distillation of coal would be a matter for the company and colliery interests. The increasing use of fuel oil was but a small factor among the causes of unemployment in coal-fields. The development of home supplies of oil was being considered by the Fuel Research Board.—(June 26.)

Exportation of Morphine.

Mr. Shortt informed Mr. Ramsden that the export of morphine from this country was prohibited except under licence and all possible steps were taken to prevent export for other than medical or scientific purposes. As the traffic could be controlled successfully only by international co-operation, the League of Nations was urging its members to adopt and enforce a system of importation certificates at an early date.—(June 28.)

"Reparation" Duty.

Sir C. Oman asked why parcels consisting of single copies of scientific works, ordered by a private individual, passed without paying "reparation" duty if sent through the post, whereas they

were charged with the full 26 per cent. levy if sent in a parcel or box through the customs department at Harwich. Sir J. Baird replied that the importation of a single copy of a book as cargo would be quite unusual, but if further information were supplied, an inquiry would be made.—(June 29.)

Answering Mr. Kiley, Sir R. Horne said that neither France, Belgium, nor Italy collected "reparation" duty on German goods, which, if sold to an independent purchaser in one of those countries, would be exempt from the levy on importation into the United Kingdom.—(July 4.)

Imports of Hollow-ware.

In reply to Mr. Gilbert, Sir W. Mitchell-Thomson said that the imports of hollow-ware from Germany during the year ended March 31, 1922, were as follows:—

	Tons.	£
Aluminium hollow-ware, domestic ..	1,014	166,775
Iron and steel hollow-ware, domestic:—		
Cast, enamelled	1,980	115,867
Wrought, enamelled	6,968	294,275

—(June 26.)

Mr. Baldwin, replying to Mr. Hogge, said it was not intended that enamelled hollow-ware imported into this country to be further enamelled should be exempt from the provisions of the draft Order.—(July 3.)

Dyestuffs (Import Prohibition) Act.

Replying to Capt. Bagley, Sir W. Mitchell-Thomson said that persons interested in importing German dyestuffs into this country had, no doubt, endeavoured to obtain from German makers price quotations that could be used as arguments for modifying the Act, but that had not been done to any great extent.—(June 28.)

Mr. Baldwin said, in reply to Mr. Hogge, that the licensing committee appointed under the Act had met 40 times; the quorum necessary for considering or refusing licences consisted of one independent member, one representative of the dyemakers and one of the dye-users.—(July 3.)

British Dyestuffs Corporation.

In answer to Mr. G. Thorne, Sir W. Mitchell-Thomson said that no reason for modifying the decision not to appoint a committee to inquire into the situation of the Corporation had arisen out of its recent annual meeting.—(June 26.)

Replying to Major Barnes, Mr. Baldwin said that the Government had power to nominate only two representatives on the Board of the Corporation. It would not be necessarily of advantage to require that no member of the board should be a director or interested in other dye or chemical companies or that at least one Government nominee should possess special knowledge of dye-making. Apart from small samples of 1 kg. each, obtained for research and experimental work, the Corporation purchased no German dyestuffs or intermediates during 1921.—(July 3.)

Exports of Perfumery.

Answering Mrs. Wintringham, Mr. Baldwin gave the following figures of exports of perfumery and perfumed spirits in 1920 and 1921:—

	1920.	1921.
<i>Exports of home manufacture:—</i>		
Perfumery containing spirit .. lb.	963,707	137,945
Perfumery, other	4,744,241	1,700,422
Spirits, perfumed, in bond .. galls.	74,518	15,406
Spirits, perfumed, not in bond ..	—	18,172
<i>Exports of foreign and colonial manufacture:—</i>		
Perfumery containing spirit .. lb.	—	559
Perfumery, other	221,658	212,871
Spirits, perfumed galls.	679	674

—(July 3.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Inquiries.—All committees appointed under Part II. are directed to report on the effect that the imposition of a duty would have on employment in any industry using goods that are the subject of the inquiry.—(June 26.)

Optical and Scientific Instruments.—Complaints of the difficulties in obtaining material for research take no account of the change in the cost of all commodities, and also in industrial conditions in Germany which have resulted in abnormal delay in delivery and a lower standard of quality. British manufacturers are making every effort to improve the quality and reduce the cost of their products, and it would be advantageous if men of science would co-operate sympathetically with them.—(June 26.)

The statement in the last annual report of the Medical Research Council that its operations have been greatly hampered by the high cost of scientific instruments and materials refers to the year ended September 30, 1921, when the Act was not in operation, and thus confirms the view that the increased cost of research is not due mainly, or even very appreciably, to the Act.—(July 3.)

Vulcanised Fibre.—The Committee on vulcanised fibre is not precluded from proceeding with the inquiry because of an increase in the price of the imported article, as the increase may be only temporary or intended to avoid the operation of the Act.—(July 3.)

Glassware.—The practicability of collecting the duties on glassware set out in the draft Order made under Part II of the Act has been discussed by the Board of Trade and the Board of Customs, but it is not intended to consult persons familiar with the trade. Imports of domestic and fancy glassware during the first five months of 1920, 1921, and 1922 were 1550 tons, 1451 t., and 1769 t., respectively.—(July 3, 4.)

Boric Acid.—The duty collected on imported boric acid from October 1, 1921, to June 20, 1922, amounted to £21.—(July 4.)

LEGAL INTELLIGENCE.

CONTRACT FOR SUPPLY OF EXPLOSIVES. *Hickson and Partners, Ltd., and Others v. The Crown.*

In the King's Bench Division on June 26, Mr. Justice Bailhache heard a petition of right against the Crown by Hickson and Partners, Ltd., of Bradford, Sharp and Mallet, Ltd., of Copley, Brotherton and Co., Ltd., of Leeds, and R. Graesser, Ltd., of Ruabon.

The suppliant companies claimed the balance of £60,000 due for TNT and picric acid supplied to the Government. When they asked for the balance of the contract price, the Crown claimed it was entitled to retain the money as a contribution, under the Munitions (Liability for Explosions) Act, 1916, to a fund for compensating damage caused by explosions to life or the property of third parties. The suppliant companies contended that such retention of moneys was not authorised by the Statute, and that the Crown had levied a contribution that was out of proportion.

After consultation, the parties arrived at a settlement on terms that were not disclosed, the Crown agreeing to pay the taxed costs of the suppliant companies.

REPORTS.

THIRTY-NINTH REPORT OF THE COMPTROLLER-GENERAL OF PATENTS, DESIGNS, AND TRADE MARKS, 1921. *London: H.M. Stationery Office. 1922. Price 6d.*

Although less business was done by the Patent Office in 1921 than in 1920, the amount was still above the pre-war average, except in regard to applications for registering designs. The decrease in the number of complete specifications for patents was due to the expiry of the extensions of time granted under the Peace Treaty and the Berne Agreement of 1920, but there was an increase in the number of provisional specifications. The following is a statistical summary of the work done during the past two years:—

	1921.	1920.
Patents:—		
Applications	35,132	36,672
Provisional	24,674	23,255
Complete	19,159	21,796
Sealed	17,697	14,191
Designs:—		
Applications	13,387	13,669
Registered	12,313	13,071
Trade Marks:—		
Applications	11,959	14,064
Registered	7,518	7,122
Letters, etc. dispatched ..	265,000	263,000
Parcels of publications dispatched ..	112,000	92,000
Patent specifications sold ..	270,707	260,368

There were 35 hearings upon oppositions to the grant of patents, and 11 appeals to the Law Officer. Of the 4278 hearings fixed under Sections 7 and 8 of the Acts, 2588 were withdrawn, and in 6 of the 1690 cases decided appeals were made to the Law Officer.

The preponderance of trade marks registered for chemical and allied products is particularly noteworthy.

The number of readers who used the library increased from 120,512 to 129,975. The new classification of the library is now complete; 6567 volumes were added to the library during the year, making the total number of works 60,347 (190,242 volumes, excluding duplicates).

Receipts from patents fees amounted to £445,947, from designs fees £9648, and from trade-marks fees £47,803. The total receipts, £525,500, represent an increase of £37,958 over 1920, and were the largest ever received in any one year. Expenditure totalled £451,912, leaving a surplus of £73,588.

REPORT ON THE ECONOMIC, COMMERCIAL AND INDUSTRIAL SITUATION OF SWEDEN, DATED MARCH, 1922. By H. KERSHAW, *H.M. Commercial Secretary, Stockholm. Department of Overseas Trade. Pp. 60. London: H.M. Stationery Office. 1922. Price 1s. 6d.*

In spite of the apparent advantage of the high exchange-value of Swedish currency and the possession of a credit balance abroad, Sweden suffered severely from industrial depression during 1921. The timber and pulp industries were subject to fluctuating prices, poor demand, and competition from Finland. The export trade in newsprint paper was fairly good, but in other kinds unsatisfactory. In the pottery industry prices were reduced by 40–50 per cent. last autumn owing to lowering of wages and reduced costs of raw materials; competition from Germany then declined significantly. The glass industry has developed considerably. Cement manufacturers have been severely hit by the almost entire suspension of building operations, and by the acute competition from neighbouring countries. With one or two exceptions, all the manufacturers are now united in a single combine.

The greatest depression of all prevailed in the iron and steel industry, whose production in 1921 was only 30 to 40 per cent. of that before the war (*cf. J., 1922, 133 n*). Although the export of matches is improving and the industry is regaining its former position in foreign markets, stocks are so large that the factories must restrict output for some time. Details of the mineral output (*cf. J., 1922, 36 n*) for 1921 have not yet been issued, but 4,330,000 t. of iron ore was exported, mainly to Germany, and there are still large stocks. Extensions and enlargements of existing hydro-electric plants have been curtailed until costs have fallen, but new stations and extensions in course of construction will increase the total capacity from 1,200,000 to 1,500,000 effective h.-p. Much attention is being paid to industrial standardisation, especially in the engineering, electrical and wood-working industries.

British methods of trading in Sweden, it is pointed out, need improving; and there will be good openings for British chemicals, china, pottery and cut-glass when conditions improve. German competition is very severe, but defective deliveries from Germany are causing much dissatisfaction.

REPORT ON THE ECONOMIC, FINANCIAL AND INDUSTRIAL CONDITIONS OF THE NETHERLANDS, DATED FEBRUARY, 1922. By R. V. LAMING, *H.M. Commercial Secretary, The Hague. Department of Overseas Trade.* Pp. 48. London: *H.M. Stationery Office.* 1922. Price 1s. 3d.

The depression in Dutch industry which marked the close of 1920 continued throughout 1921, the decline in foreign, and especially the German, exchanges and the eight-hour day Act being particularly adverse factors. In the coal industry supplies improved, but the output of 3,927,000 tons was not much larger than in 1920, and receipts did not cover costs of production. Work on new shafts was continued and a new canal system has been completed. Owing to the fall in the price of coal, production of lignite declined by 1,181,000 t. to 117,000 t., and the peat industry became stagnant. The salt mine at Winterswijk passed through a difficult period, the duty on refined salt being insufficient to protect the refineries, of which only four are working.

Agriculturally the year 1921 was satisfactory, but the area under and the yield of flax both declined. In the colonies, the agreement between the cinchona factories and the plantations was renewed. Most Dutch East-Indian plantation companies, except, perhaps, the sugar companies, passed through a difficult period and the improvement in the world's market at the end of the year probably saved many of the rubber companies from extinction. A company was formed by the Royal Dutch Petroleum Co. to develop the Djambi oilfields under Government control.

Imports during 1921 declined in value by 1,092,073,970 gulden to 2,240,353,120 gulden, and exports by 331,871,111 gulden to 1,701,491,711 gulden (gulden=1s. 8d. at par), but by weight the former increased by 3·4 and the latter by 1·5 million tons. Exports of coal, 557,400 t., bunker coal, 696,700 t., refined sugar, 159,800 t., and condensed milk, 74,000 t., increased, but those of paper, textiles, vegetable produce, and margarine (69,500 t.) decreased. There was an increase in the importation of earthenware, stone and similar products, but serious declines in metals, minerals, yarn and textiles. Imports of coal amounted to 4,891,000 t. (2,969,000 t. in 1920), the United Kingdom supplying 1,784,000 t. Increases were shown in the volume and decreases in the value of imports of vegetable oil, the raw material being most in demand. Germany took first place in the

import trade with 629 mill. gulden, followed by the United States with 392 mill. g., Great Britain with 311 mill. g., and Belgium with 227 mill. g. Of the exports Great Britain took 350, Germany 254, Belgium 167, and the United States 46 mill. g.

At the date of the report trade prospects were far from hopeful. Germany was losing ground owing to delay in executing orders and to insecurity of payment. As the British exchange has remained stable and prices have decreased, the demand for British goods will improve if prices of raw materials continue to decline.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for June 29 and July 6.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REFERENCE NUMBER.
Argentina	Pottery	225/G.F.G. M.C./C. 15
Australia	Sheet and plate glass	3
"	Chemicals, plaster, clays, etc. for the pottery industry ..	†
"	Chemical and pharmaceutical products, drugs	8851/E.D./G.C.
British India ..	Cement, soap, chemicals, rubber goods, dyes	6257/F.L./S.C.2
Cuba	Liquid coal-tar disinfectant ..	721
Czechoslovakia ..	Chemicals for the glass, paper and textile industries ..	722
Danzig	Chemicals for sugar-refining, machine oils and fats ..	5790/F.R./M.C.
Denmark	Gasworks pitch	737
Egypt, India, Turkey	Tinplate	723
France	Paper	11
"	Metals	12
"	Porcelain tiles	16011/F.W./G.C.A.
Holland	Paint, lithopone, turpentine oil, carbolic and nitric acid, graphite, gum arabic, ether, naphthalene, yellow ochre, white soap	16011/F.W./G.C./D. 225/33/F.G.M.C. 225/29/F.G. 8
"	Firebricks, fireproof cement ..	738
Peru	Pottery	739
South Africa ..	Glass, glassware, pottery ..	
United States ..	Galvanised iron	
"	Drugs, gelatin, citric acid, gum	
"	Refractory bricks, China clay, coke, pig iron, tinplate, chalk	

† Ref. No. 412/20/7/3080. Official Secretary, Commercial Bureau, Australia House, Strand, W.C.2.

TARIFF. CUSTOMS. EXCISE.

Australia.—The drawback on goods which have been imported into and undergone further manufacture in the United Kingdom may be deducted from the value declared for customs duty on re-export to Australia.

Barbados.—Customs duties have been increased by one-fifth on all dutiable imports except charcoal, edible oils, cottonseed, and kerosene.

Belgium.—From June 24, an import duty of 10 francs per hectolitre has been imposed on light oils or spirits of a density less than 0.77 at 15° C. derived from mineral oils. From June 30, aniline dyes may only be imported under licence, but do not require a certificate of origin.

Canada.—Recent modifications of the customs tariff affect various kinds of paper.

Egypt.—Consignments of fertilisers will not be admitted after August 1 unless accompanied by an official certificate of analysis.

Fiji.—It is proposed to reduce the export duty on copra from 20s. to 15s. per ton.

France.—The "co-efficients of increase" applied to the import duties on many vegetable oils, mineral and paraffin wax, aluminium sulphate, lactose, and manufactures of copper have been modified.

New Zealand.—Definitions of oils for customs purposes are given in the issue of June 29. Photographic plates are admitted duty-free under the British preferential tariff, but pay a duty of 15 per cent. *ad valorem* under the general tariff.

Poland.—The customs surtax applied to the duties on printing and other paper has been reduced.

St. Christopher and Nevis.—Recent amendments to the customs tariff affect explosives and spirits. The schedule of export duties on sugar, syrup, molasses, cotton, and coconuts has been revised.

Sierra Leone.—The importation of methylated spirits that contain less than 10 per cent. by volume of wood naphtha and 0.385 per cent. of mineral naphtha (sp. gr. 0.800) is prohibited.

The Vereinigte Glanzstofffabriken A.-G. in Elberfeld states that there was a strong home demand for its products throughout its past financial year, and that it did practically no export trade, in spite of very attractive foreign prices. Every effort is being made to increase production, and the reconstituted factory in Sydowsane has already a good production. The firm's interests in Germany and abroad have been extended. The balance for the year was 50,044,132 mk. (42,977,350) out of which dividends amounting to 30 per cent. (20) have been paid, and large sums placed to reserve.

The Schering Chemical Works, Berlin, G.m.b.H., has been formed with a capital of 200,000 mk. to market the products of the Schering Co. abroad and to import and export goods.

The A.-G. Lithoponefabrikation, Berlin, has declared a dividend of 35 per cent. The brisk demand for the company's products still continues and prospects for 1922 are considered favourable.

The Sacharin-Fabrik A.-G. vorm. Fahlberg, List and Co. in Magdeburg is paying a dividend of 15 per cent. and a bonus of 10 per cent., as in the previous year. Prospects are said to be very good.

At the recent meeting of the Gesellschaft für Linde's Eismaschinen A.-G., it was decided to distribute a dividend of 25 (20) per cent., and to double the share capital.—(*Chem. Ind.*, Apr. 17, 24, 1922.)

Foreign Chemical Trade of Sweden in 1920 and 1921.—The imports and exports of chemicals and related products in 1920 and 1921 were as follows:—

TRADE NOTES.

FOREIGN.

German-Swiss Trade in Chemicals.—Official Swiss statistics of the chemical trade between Germany and Switzerland are given below:—

Swiss imports from Germany:	1913.	1920.	1921.
		Metric tons.	
Pharmaceutical products ..	2,097.3	878.3	779.7
Perfumery ..	64.1	91.0	52.4
Alumina ..	3,770.4	13,913	13,071.8
Acetic acid, crude ..	769.3	475.3	312.0
Methyl alcohol ..	1,208.7	476.1	422.9
Tar-oil derivatives ..	3,132.7	6,391.0	3,680.7
Dyes ..	0,371.9	3,360.9	2,870.2
Including coal-tar dyes ..	669.8	495.6	362.4
Chemicals, total ..	84,217.7	52,522.7	34,403.8
Insic slag ..	47,748.7	2,054.0	9,137
Potash fertilisers ..	13,223	12,217.3	6,155
Swiss exports to Germany:			
Calcium carbide ..	25,013.2	1,736.2	1,250.2
Glue and gelatin ..	767.4	810.1	651.1
Chemicals, total ..	49,437.3	5,231.4	3,835.7

The chemicals imported from and exported to Germany by Switzerland in 1921 were valued at 17,841,000 francs and 3,896,000 fr., respectively.—(*Chem. Ind.*, Apr. 24, 1922.)

German Company News.—Meister, Lucius u. Brüning, F. Bayer u. Co. and the A.-G. für Anilin-Fabrikation are paying dividends of 30 per cent. each for 1921, *i.e.*, 10 per cent. more than in 1920. The Chemische Fabrik Griesheim-Elektron has raised its dividend from 16 to 27 per cent. Meister, Lucius u. Brüning, whose capital was increased to 430 million mk. in 1921, and 470 mill. mk. in May, 1922, made a net profit of 3.45 mill. (2.74) mk. carried forward 175.80 (61.54) mill. mk. and placed 1 (3.30) mill. mk. to reserve. F. Bayer u. Co., with the same capital, made a net profit of 201.43 (102.17) mk. and carried forward 3.05 (2.49) mill. mk. (*cf. J.*, 1922, 171 n).

	1920.	1921.
	Metric tons.	
Imports:—		
Sodium nitrate ..	23,043.6	20,050.9
Caustic soda and potash ..	5,375.5	4,224.4
Potassium chloride ..	6,058.2	1,284
Chloride of lime ..	9,028.7	1,853.3
Sodium sulphate and bisulphate ..	50,337.6	13,453.1
Calcium nitrate ..	22,302.5	14,855.0
Potassium carbonate ..	1,909.1	603.8
Soda, sodium bicarbonate ..	18,783.4	8,804.4
Potash salts (Stassfurt) ..	49,508.2	37,625.4
Thomas phosphate ..	—	5,801.5
Phosphate, crude ..	112,853.3	70,227.8
Mineral oils ..	189,729.8	145,539.2
Coal tar ..	11,370	2,818.1
Vegetable oils and fats ..	17,690.3	12,196.2
Zinc white, lithopone, barytes ..	5,310.6	5,037.8
Vegetable tanning materials, extracts ..	3,589	4,007.4
Sugar, refined ..	29,965	6,800.6
Hides and skins, raw ..	11,011.5	9,945.1
Salt, domestic ..	26,843.4	26,765.3
Coke ..	358,259	235,022
Coal ..	2,806,303	1,458,188
Sulphur ..	57,659.5	21,037.9
Pyrites ..	114,000	58,002
Pyrites cinders ..	18,369	15,839.0
Iron and steel ..	115,351	58,065
Iron, pig and scrap ..	97,526	23,514
Copper, crude ..	18,178	6,192
Exports:—		
Calcium and barium carbides ..	7,897.2	6,544
Potassium and sodium chlorates ..	2,785.3	1,582
Calcium cyanamide ..	100.2	—
Copper sulphate ..	151.6	69.7
Superphosphate ..	42,375.7	18,382.1
Other chemicals ..	1,650	1,445.5
Pulp, wood:—		
Mechanical, wet ..	214,210	88,500
Mechanical, dry ..	57,755	15,290
Sulphite cellulose, bleached ..	44,162	16,153
Sulphite cellulose, unbleached, wet ..	40,733	5,614
Sulphite cellulose, unbleached, dry ..	511,859	298,562
Sulphate cellulose ..	140,548	102,701
Cardboard, paper, etc. ..	284,998	183,095
Cement ..	68,131	28,039
Felspar ..	16,947	20,252
Matches, wooden ..	36,450	19,975
Matches, safety ..	34,800.4	18,510.5
Iron and steel and manufactures of ..	222,677	124,600

Preliminary statistics give the value of Swedish imports as 3,373,484,826 kronor in 1920, and 1,266,237,483 kr. in 1921 and of the exports as 2,293,587,083 kr. and 1,097,273,992 kr. in the two years, respectively (krona=1s. 1½d. at par, now roughly 1s. 2d.).

REVIEWS.

GAS CHEMISTS' HANDBOOK. *Compiled by the Chemical Committee, Technical Section, of the American Gas Association. Second edition, March, 1922. Published by the American Gas Association. Price \$6 net.*

The work under review is published by the American Gas Association for the use of chemists in gas undertakings, for whom it will form a manual of great value, containing as it does a fairly complete account of the analytical and control methods commonly used there in gas works and coke-oven installations. The different sections have been written by chemists actually engaged in the work who for the most part give a clear and well-reasoned account of the methods described and of the precautions necessary in carrying them out. For British chemists the value of parts of the book will be less than for chemists in America, as certain of the methods described are inapplicable to British conditions, partly because in the different countries the type of apparatus employed has developed on different lines (e.g., in the case of gas analysis), and partly because several of the methods are of an empirical nature, in which certain specified conditions of test must be complied with, and the conditions agreed upon differ in the two countries. Nevertheless a very considerable proportion of the book will be equally useful here, and even where the methods employed differ, a study of the other methods may often be helpful in devising means of improving the tests employed here in speed or accuracy or in both respects.

The very important matter of the correct sampling of the materials tested, whether solid, liquid or gaseous, frequently so inadequately treated in books of this kind, receives extended treatment, the methods given being, for the most part, those prescribed by the American Society for Testing Materials and the Bureau of Mines. Space does not permit of an extended criticism of the methods of analysis prescribed, but in general these appear to be satisfactory, and in accordance with present knowledge. A point to be commended is the statement in connexion with many of the tests of the "tolerance" which is allowable between duplicate tests made by the same observer, and also between different observers testing the same sample.

On the other hand, certain of the methods given seem to be distinctly inferior to those used for the same purpose in this country. For example, the most unsatisfactory chapter in the book is that relating to cyanogen (possibly because very little in the way of extraction of cyanide products is carried out in American gas works). Practically the only method described for the determination of ferrocyanide is that of titration with copper sulphate according to the plan first described by Bohlig in 1862, and no mention is made of the more recent methods, such as those of Feld and Williams, in which the amount of hydrocyanic acid in the products is determined, and which are much more accurate and more easily and quickly carried out. Sulphocyanides, which are here often of considerable importance, barely receive mention, and no methods of analysis are given. The method given for the determination of naphthalene in gas by means of picric acid, appears very cumbersome and liable to considerable experimental error, and inferior to several of the modifications of the picric-acid method in use here. No mention is made of the method now in general use here of determining the amount of sulphur, excluding tarry matter, in spent oxide, by heating the extracted sulphur and tar with concentrated sulphuric acid at 100° C., which is far more preferable to the tedious and unpleasant method of treating the mixture of sulphur

and tar with nitric acid and chlorate, and subsequently precipitating the sulphuric acid formed as barium sulphate.

The book is well printed and illustrated, and although, for the reasons given above, it cannot be as suitable to British as to American chemists, it will nevertheless be a valuable addition to the laboratory library in gas works and coke-oven installations in this country.

H. G. COLMAN.

SEWERAGE AND SEWAGE TREATMENT. *By Harold E. Babbitt. Pp. xii.+531. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1922). Price 25s. net.*

This book, as the author points out in the preface, is the development of a series of classroom and lecture notes. It would, therefore, not be fair to compare it with the many larger treatises which have been compiled on these two wide and complex subjects, but there are, nevertheless, in the text illustrations, tables, diagrams and data which will help both the student of sanitary science and the sanitary engineer.

Introducing each branch of the subject with a discourse on the pure theory and passing on to a description of the execution of the work and the finished plant (in some cases with notes of the working of the installations), the author impresses the reader with the feeling that he is well abreast of the times in his information. Since the subject of sewage treatment and disposal is one which must of necessity be regarded in the light of theory and experience combined, this academic method should appeal to the student.

Although it is not reasonable to look for a chapter on every branch of the subject in a work of this size, it will be found that the author has covered most of the ground available to him without going into too many details.

Most writers deal with the sewage problem as the result of having studied it in different countries, but the author has confined his remarks and examples exclusively to American practice, a fact which should be borne in mind by the reader since the American engineer does not invariably aim at the same goal as his brother professional in this country. For instance, quickness of construction and cheapness of production are not infrequently accepted in the States as meritorious when they would not be so accepted in England if they militated in the least degree against efficiency.

The careful study of what is being done in any one country where sanitation is taken seriously and the tale of successes, failures and general vicissitudes through which the sewage problem has passed are bound to be educative, and are interestingly told by the author to his readers.

As America is the home of the system known under the name of Dilution, one would naturally expect a sound practical reference to it, and in this the reader will not be disappointed.

The chapters on Work Preliminary to Design (of sewerage systems), Quantity of Sewage, and Pumps and Pumping Stations contain much valuable and interesting instruction and include data on construction and maintenance, on the selection and characteristics of the different makes of pumps and on general equipment, sufficient for most needs of the sanitary engineer.

Other chapters of special note to the reader are found under the headings Sedimentation of Sewage and Activated Sludge. In these the principles of the working of the Imhoff Tank and its design and treatment are dealt with fully, whilst a table of bibliographical references on activated sludge emphasises the fact that only by carefully following

detailed descriptions of what has been and is being done in various places can one hope to strike a true balance of the relative merits and demerits of this method of sewage purification, which is still in its infancy.

The twenty-one chapters of this book form not only an attractive synopsis of the history of sanitation and the development of sewage purification written by the able pen of a man who has kept pace with the times, but they contain a wealth of illustrations, tables, diagrams, costs, quotations from specifications, and descriptions of execution of work.

J. D. WATSON.

THE CORROSION OF IRON. By DR. J. NEWTON FRIEND. *Carnegie Scholarship Memoirs. Vol. XI. Pp. vi+161. Published by the Iron and Steel Institute, 28, Victoria Street, London, S.W. 1. 1922. Price 16s.*

This is a special volume, issued by the Iron and Steel Institute as a Carnegie Memoir. It deals with the present state of knowledge on the corrosion of cast iron and steel: the protection of iron; the influence of temperature on the rate of corrosion; and the colloid theory of corrosion. This theory has been developed by Dr. Friend, and a number of new and interesting observations and experiments are recorded. The report is likely to be a standard of reference, and should be read by all interested in this subject.

We have received the subjoined correspondence relating to the review of Mr. F. F. P. Bisacre's book "Applied Calculus" which appeared in our issue for May 15.

Mr. Bisacre writes:—

"Certain questions of fact arise in connexion with the review to a few of which I should like to direct your attention. (1) The reviewer states that "In this work the conception of ∞ —the vanishingly small infinitesimal—is developed exclusively by the method of limiting values."

The two methods by which the Calculus may be approached are both given in the book, namely, the usual method of Limits, and the method of "Infinitesimals," but "the conception of ∞ —the vanishingly small infinitesimal"—is not developed in the book for the reason that it is an exploded doctrine of the seventeenth century. The work of Weierstrass, Cantor, Hardy, Hobson and Whitehead—to name a few pure mathematicians—has finally disposed of a doctrine that Bishop Berkeley poked fun at so successfully. The reviewer must forgive me for trying to avoid the false doctrines of the past.

(2) In the reviewer's remarks on my treatment of the exponential function, after saying that the author does so and so, he says: "... he proves that the derivative of e^x is e^x ." The author neither *proves* nor pretends to *prove* this, in a mathematical sense. The method he has used is entirely an experimental one, which leads the reader, in a practical fashion, to discover for himself, with the aid of a book of tables, the properties of the exponential function and logarithms, and the author says this and disclaims any pretence to mathematical rigour in the following passage: "The theory of these functions is difficult, and proved a formidable stumbling-block in the history of mathematics. The theory is best worked out by methods beyond the scope of this book, and for the present we shall take the tables for granted, and endeavour to ascertain the most important properties of the functions from these tables."

(3) In criticising the method of obtaining the derivative of $\sin x$, the reviewer has left out three

essential lines of working and two references, and goes on to say: "To students who are not expected to have a knowledge of algebra beyond quadratic equations, the seeing of this equation means that they have advanced further in trigonometry than is usually taught to such." What the author actually says in the Preface as to preliminary mathematical equipment is this: "All the mathematics that the student is assumed to know is algebra up to quadratic equations; *elementary trigonometry up to the formulae of sines, cosines and tangents of compound angles*; the elements of geometry; and the method of graphs."

(4) The reviewer writes as follows: "In the Preface the author states that infinite series are avoided altogether as being difficult and unconvincing, yet he is driven to Taylor's series; . . ." What the author says is "Infinite series are essentially difficult and unconvincing *unless treated rigorously*—as the old conundrum of Achilles and the tortoise shows—and there is no need to use them in the elementary parts of the subject." As to the reference to Taylor's series, there is not a Taylor's series in the whole book!

PUBLICATIONS RECEIVED.

INORGANIC CHEMISTRY. By PROF. T. M. LOWRY. Pp. 943. (London: Macmillan and Co., Ltd. 1922). Price 28s. net.

CATALYSIS WITH SPECIAL REFERENCE TO NEWER THEORIES OF CHEMICAL ACTION. A General Discussion held on September 28, 1921, by the Faraday Society. Reprinted from the Transactions of the Faraday Society, Vol. XVII. Part 3, May, 1922. Pp. 546—675. Price 9s.

L'AZOTE: LA FIXATION DE L'AZOTE ATMOSPHÉRIQUE ET SON AVENIR INDUSTRIEL. By PROF. L. HACKSPILL. *Encyclopédie Léauté.* Pp. 271. (Paris: Masson et Cie. and Gauthier-Villars et Cie. 1922). Price 14 fr.

LES PROGRÈS DE LA MÉTALLURGIE DU CUIVRE. By PROF. A. CONDUCHÉ. *Encyclopédie Léauté.* Pp. 254. (Paris: Masson et Cie. and Gauthier-Villars et Cie. 1922). Price 14 fr.

LES COLLOÏDES. By J. DUCLAUX. Second edition, revised and enlarged. Pp. 305. (Paris: Gauthier-Villars et Cie. 1922). Price 10 fr.

DER PAPIER-FABRIKANT. Vol. 20, No. 23A. Special edition for the Jubilee of the Verein Deutscher Papierfabrikanten. Pp. 408. (Berlin: Verlag Otto Elsner. 1922). Price 4s. 6d.

DIE LÖSUNGSMITTEL DER FETTE, ÖLE, WACHSE UND HARZE. By DR. H. WOLFF. *Monographs on the Chemistry of Fats*, edited by PROF. K. H. BAUER. Pp. 118. (Stuttgart: Wissenschaftliche Verlagsgesellschaft. 1922). Price 9s.

WERKSTOFFE: HANDWÖRTERBUCH DER TECHNISCHEN WAREN UND IHRER BESTANDTEILE. Vol. I. A.—F. Vol. II. G.—R. Vol. III. S.—Z. By PROF. PAUL KRAIS and collaborators. Pp. 529, 784, and 728, respectively. (Leipzig: J. A. Barth. 1921). Price, paper, 450 marks, bound, 540 mk.

REPORT OF THE FUEL RESEARCH BOARD FOR THE YEARS 1920, 1921. SECOND SECTION: LOW-TEMPERATURE CARBONISATION. Department of Scientific and Industrial Research. Pp. 73. (London: H.M. Stationery Office. 1922). Price 2s.

REVIEW

Vol. XLII

JULY 31, 1922

[No. 14

THE ANNUAL MEETING IN GLASGOW

VISIT TO THE ARDEER FACTORY OF NOBEL'S EXPLOSIVES CO., Ltd.

AT the invitation of the Directors of Nobel Industries, Ltd., 100 members visited the above factory on Saturday, July 8. The party travelled by special train from St. Enoch Station, Glasgow, and on reaching Stevenston was conveyed on the company's private line to the Ardeer Factory. On behalf of Nobel Industries, Ltd., the guests were welcomed by Sir Ralph Anstruther, Lord Cochrane and Mr. Rogers, and by Mr. J. A. Cockburn, works manager of the factory.

The visitors were divided into parties, and each party was conducted through selected portions of the factory by a member of the chemical staff.

The site of this factory was selected by Alfred Nobel in 1871. On its front it faces the Firth of Clyde, and the factory covers an area considerably over a thousand acres. The guests first of all visited the boiler station, where 19 Lancashire boilers distribute steam through more than 20 miles of piping. The fuel for these boilers is entirely mechanically handled. After visiting the Power Station, where the turbo generators and air-compressors were examined, the parties entered the "danger" area and were conducted to the summit of one of the "nitroglycerin" hills, from which an extensive view of the factory was obtained. It was at once apparent—and the photograph makes this clear—that the term "factory" is rather misleading, for, instead of one building or group of allied buildings, the Ardeer works consists of hundreds of distinct and widely separated houses, many of which are surrounded by high sand-embankments.

The plant for the manufacture of nitroglycerin was briefly described, and a typical nitrating house was shown, the lead-lined nitrators in which yield one ton of nitroglycerin per charge.

The parties then descended the hill and passed through a portion of the Blasting Department. Although no more than a department at Ardeer, it is the largest blasting-explosives factory in Europe. After visiting one of the "Gelatin" houses where blasting gelatin and gelignites are made, each party was conducted to the Dynamite Huts, where an exhibit of various blasting and propellant explosives was inspected. Blasting explosives may be broadly classified

in two sections: the gelatinous type and the powder type. Among the former class may be mentioned Blasting Gelatin, Gelatin Dynamite and Gelignites, whilst Samsonite No. 3 and Super Rippite No. 2 are "permitted" gelatinous explosives, i.e., their use in fiery mines is sanctioned by the Home Office. It is interesting to note that, after the invention of dynamite by Nobel in 1866, he continued his researches in the hope of obtaining some substance which, while itself powerfully explosive, would dissolve in nitroglycerin and convert it into a jelly. The outcome of these investigations was the discovery of Blasting Gelatin in 1875. Among the "permitted" powder explosives may be mentioned Viking Powders Nos. 1 and 2, Thames Powder No. 2, Rex Powder, Stomonal No. 1, Super-Cliffite No. 3, and Dynobel No. 3. A very large number of blasting explosives, among which may be mentioned Quarry Monobel and Rockite, are made for ordinary and special blasting purposes.

Another interesting exhibit was that of Tonite, a compressed mixture of barium nitrate and guncotton. This explosive is manufactured for use in submarine demolition, in distress-signal work, and for blasting. Tin canisters were exhibited which contained quantities of Tonite up to 200 lb. These larger charges are prepared for submarine and special demolition purposes. A number of distress signals, which may be fired either by ordinary ignition or by percussion, were also inspected.

The next hut contained an exhibit of propellant explosives manufactured for military, naval, and sporting purposes. Cordites of all sizes, from those for the 15-inch gun to the magazine rifle and revolver, were inspected. A specially interesting exhibit was a comparatively new propellant called "Ardeer Cordite." During the last few years much research work has been carried out at Ardeer on the preparation of cordite without the use of alcohol and other volatile solvents, thereby avoiding the use of potential foodstuffs in times of national emergency. A process on these lines has now been devised whereby "Ardeer Cordite" in any size may be prepared from nitroglycerin and nitrocotton, and despatched for proof and use in a single day. This cordite possesses many desirable features, not only as regards

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ballistics and stability, but also from the standpoint of manufacture. Among the manufacturing advantages may be mentioned the fact that wet nitrocotton is used, thereby avoiding the dangers always incident upon the drying of nitrocottons. Nitrocellulose powders, both for field guns and rifles, were exhibited, including the special powders used in the match rifle competitions at Bisley and progressive powders for use in high-velocity military rifles. Many varieties of sporting powders of both condensed and bulk nitro types were shown. Ballistite, the standard condensed powder invented by Nobel in 1888, and the forerunner of cordite, was exhibited in various sizes both for use in small arms and ordnance. This was the propellant used for the trench mortar during the late war. The bulk nitro types of sporting powders, of which E.C., Empire and Schultze powders were shown, are characterised by the necessary charge occupying the same volume as the older, heavier charges of black powder.

Leaving the "danger" area, the parties proceeded to the Acids Department and inspected the glycerin-distillation plant, where saponification and soap-lye glycerins are distilled prior to their conversion into nitro-glycerin. One of the Tentelew units, for the manufacture of oleum, was next inspected. Arsenical pyrites is used as the source of sulphur in this contact process, and this factory is the only private factory in the Kingdom where the Tentelew process is employed. Nitric acid, of concentration up to 90 per cent., is made from sodium nitrate, and the mixed sulphuric and nitric acids are subsequently employed for the manufacture of nitroglycerin and of various types of nitrocotton. A short inspection was also made of the towers used for denitrating spent acids and the concentration of weak nitric acid. Kessler plants are employed for the concentration of sulphuric acid obtained from the various refuse acids. In this department lead nitrate is manufactured for the preparation of pigments, and there is also a plant for the purification of trinitrotoluene.

Unfortunately, time did not permit of a tour round the Research Department. This section consists of extensive laboratories equipped for special purposes and is staffed by 30 chemists and physicists, together with many specially trained assistants. During the winter months classes in chemistry and closely related subjects are conducted for the benefit of the apprentices and assistants, and these classes are recognised as a part of the diploma course of the Royal Technical College, Glasgow. The department is organised so that there is always intimate contact between manufacture and research, whilst special laboratories have been erected where semi-manufacturing experiments may be carried out. The department has repeatedly worked in collaboration with Government departments, and is at present giving assistance

to the committee recently appointed by the Government to consider the testing of permitted explosives. The Library, containing over eight thousand volumes, is unique among commercial libraries, and a librarian, a staff of indexers and reporters are continuously employed in the abstraction, indexing and distribution of scientific and other useful information. The majority of pure and applied scientific journals, both British and foreign, are always available. In addition, a card-indexing system was instituted some years ago and now embodies over a quarter of a million cards (*cf.* J., 1919, 37R).

A most interesting exhibition of the products of the various factories of Nobel Industries, Ltd., was inspected in one of the large rooms of the general offices. Samples were on view from the following constituent companies:—Nobel's Explosives Co., Ltd.; Kynoch, Ltd.; Curtis's & Harvey, Ltd.; Lighting Trades, Ltd.; Necol Industrial Collodions, Ltd.; Eley Bros., Ltd.; British Pluviusin Co. (1920), Ltd.

After this inspection the guests were entertained to lunch. Sir Ralph Anstruther presided, and at the conclusion proposed the toast of the Society of Chemical Industry, to which Dr. E. F. Armstrong, in the unavoidable absence of the President, Dr. R. F. Ruttan, replied.

After lunch the visitors proceeded to the Testing Station and inspected the apparatus for testing blasting explosives. The firing pit, consisting of a large steel autoclave buried in sand and used for firing explosives at a loading density comparable with that employed in mines, was first examined. The apparatus is arranged so that samples of the gases, evolved on explosion, may be easily withdrawn and analysed. Two ballistic mortars used for determining the strength of explosives were then shown; one of these is an exact replica of that used by the Home Office for testing the strength of permitted explosives. An apparatus for determining the length and duration of flame of blasting explosives was examined and several photographs illustrating the flames obtained with various types of blasting explosives were exhibited. In the calorimeter room a selection of calorimeters for use in measuring the heat evolved on exploding both blasting and propellant explosives was seen. The Bichel pressure-gauges used to measure the pressure developed by explosives when detonating were inspected, together with typical charts obtained in this test. This apparatus consists of a strong steel cylinder resting on a concrete foundation. The charge to be tested is placed in the chamber on a small wirework tripod and fitted with an electric detonator fuse, of which the wires are carried through the walls of the cylinder. The explosive chamber is closed by means of a strong steel cover and the air in the chamber may be exhausted. Vertically above the test charge is an adjustable valve-attachment, and a pencil



THE ARDEER FACTORY OF NOBEL'S EXPLOSIVES CO., LTD.

or stylo is adapted diagrammatically to mark a rotary drum set in motion by a motor. In the same room, the Fall Hammer Apparatus used for determining the sensitiveness to shock of various explosives was exhibited. The next apparatus examined was the Mettegang Recorder used for determining the rate of detonation of explosives, and the method of working of the apparatus was portrayed diagrammatically. The action of this recorder is purely electrical, so that errors of observation are eliminated to a great extent.

The visitors then passed through the engineering and instrument-makers' workshop, where much of the finer apparatus used in the examination of explosives is made, and proceeded to an experimental press house erected solely for studying the phenomena underlying the pressing of gelatinised propellant explosives. The climatic magazines were pointed out, where experimental explosives are stored in hot dry and in hot, moist atmospheres and their stability under these storage conditions examined. These magazines are constructed so that the regulation and measurement of temperature are entirely automatic. Further, the explosive samples are stored in separate fire-proof cells, so that the decomposition and ignition of one sample cannot be communicated to the samples in the adjacent cells.

The last inspection was that of the Safety Explosives Gallery. This gallery is an exact replica of the Home Office Gallery at Rotherham, where the Government testing of proposed "permitted" explosives is carried out. The test consists of finding the maximum charge of the explosive which fails to ignite both a sensitive mixture of coal gas and air and a mixture of coal dust and air. Testing is continued until the maximum charge is found which does not ignite these mixtures for five successive shots. This maximum charge is called the "charge-limit" of the explosive and in fiery mines not more than this quantity is allowed to be used in one borehole.

DEMONSTRATIONS

Preliminary experiments were carried out to show the various methods of firing explosives and the difference between burning and detonation. The difference between explosion depending on rapid burning and explosion due to detonation was illustrated by firing gunpowder by safety-fuse alone and dynamite by a detonator fired by safety-fuse and by a detonator fired electrically. The difference between burning and detonating the same explosive was effectively displayed by igniting a cartridge of Cambrite No. 2 by a flame and a similar cartridge of the same explosive detonated by a No. 6 detonator.

The carrying out of the following tests was then demonstrated:—

(a) *The Lead Block Test*, in which a definite weight of explosive is fired in a cavity in a lead

cylinder and the increase in volume of the cavity measured. This increase gives a rough indication of the shattering power of the explosive.

(b) *The Ballistic Mortar Test*, in which the explosive is contained in a cavity in the side of a steel mortar which forms the bob of a large pendulum. The shot is tamped by a steel block which forms a sliding fit in the first block. When the shot is fired the magnitude of the recoil of this large pendulum gives a measure of the heaving effect of the explosive.

(c) *The A.D.C. Test* for determining the maximum length of air-gap through which explosion can be transmitted from one cartridge to another.

(d) *The Velocity of Detonation Test*: by the D'Autrache method. This method is not an absolute method such as that in which the Mettegang recorder is employed. TNT fuse, a thin lead tube containing a core of compressed trinitrotoluene, is employed in this test and the results obtained depend on the rate and uniformity of detonation of this fuse.

(e) *Safety Explosives Gallery Test*: Shots were fired showing the ignition of coal-gas-air mixtures and of coal-dust-air mixtures by means of explosives.

The guests were then assembled in order to observe a demonstration of some of the properties and practical applications of explosives. The first experiment, in which a cartridge of Blasting Gelatin was placed (a) a little distance above an iron plate, (b) in contact with a plate, and (c) "tamped" or confined on a plate, illustrated the effect of "tamping" an explosive. The last method is much used for cutting steel plate in the destruction of old ships. The next experiment illustrated a typical application of explosives in the removal of obstacles. A row of cartridges was laid close up to the foot of a wooden palisade and confined by a banking of earth. A single shot served to remove completely the whole of the palisade. An example of the application of explosives in modern agriculture was illustrated by constructing a trench by a single detonation. In the next experiment a large cast-iron ring, weighing over 3 tons, was satisfactorily broken up for the scrap-iron heap by the application of a "plastic" shot to the inner face of the portion of the ring in contact with the ground. As a companion experiment a large iron pot, weighing over 5 tons, filled with water, was completely demolished by a single explosive charge fired under the water. In this case the application of a "plastic" shot would be unsatisfactory, owing to the shape of the pot and the danger that would be incurred from flying metal. A series of distress and sound signals was next discharged. Distress signals are very complicated in design, but consist, essentially, of a charge of gunpowder for propelling the signal from the firing socket into the air, a charge of colour composition, which is expelled away from the main charge by a small compressed

gunpowder charge, and a main charge of Tonite which is detonated by means of a time-fuse and detonator. Sound signals are used in light-houses during foggy weather. They consist of a charge of compressed Tonite and are inserted in a revolving-wheel device which detonates them at regular intervals by means of a detonator inserted in them. The last experiment illustrated the use of explosives in labour-saving by the demolition of a chimney stack. Owing to the proximity of the stack to other buildings, it had to be brought down in a definite direction. Bricks were removed from the base of the stack, leaving supporting pillars on that side of the stack towards which it was required to fall. These pillars were then bored and charged with the requisite weight of explosive.

The thanks of the Society are due to Sir Harry McGowan and the Directors of Nobel Industries, Ltd., for their hospitality; to the members of the Chemical Staff who acted as guides and interpreters; and, not least, to Dr. H. Hepworth for supplying the above account of the visit.

CATALYSIS THROUGH AMERICAN SPECTACLES

E. F. ARMSTRONG and T. P. HILDITCH

THE Committee on Contact Catalysis of the Division of Chemistry and Chemical Technology of the American National Research Council has published its first report, written by the Chairman, Prof. W. D. Bancroft, in the form of a serial story appearing in the pages of the *Journal of Industrial and Engineering Chemistry* (April-July, 1922).

The subject is surveyed thoroughly and incisively, the views of the upholders of various theories are given exhaustively and illustrated by well-chosen extracts from their published papers, and the report is enlivened by considerable humour—a mode of treatment which may be recommended to the discreet attention of most writers of scientific literature. The Committee states that it seemed the best thing it could do in its first report was to outline, as clearly as possible, the present situation in regard to contact catalysis. After that, it should be a relatively simple matter to determine what to do next. One rather gathers that the result has been to discover objections to all the theories of contact catalysis at present in the field, so that “what to do next” should resolve itself into the establishment of a really satisfactory sound explanation, pleasing alike to physical chemists of all schools and also, let us hope, to the mere chemist.

The “radiation” hypothesis fares worst: the paucity of experimental evidence, or, rather, the apparent indifference of its exponents to the desirability of experimentally, as well as

hypothetically, correlating infra-red absorption with catalytic action in as many cases as possible, is stressed, and the conclusion reached is that “it is quite extraordinary that a theory like this should get a scientific standing with apparently nothing back of it.” It is, however, in regard to the treatment of the other two hypotheses—“intermediate compound” and “adsorption”—that we are tempted to join issue with the Committee, which seems very impossible to please: but perhaps destructive criticism is so easy.

The present writers’ disavowal of precise knowledge of most of the “unstable intermediate compounds” (in the transient existence of which they have been led to believe from a consideration of the chemical transformations in hand) is quoted *in extenso*, including the statement that they might well be as “indefinite” as the adsorption of dye by fibre,¹ and is followed by the criticism that though we believe firmly in the formation of definite intermediate compounds, our conception of an intermediate compound is so elastic and our knowledge of the compositions of the assumed intermediate compounds is so limited that there would probably be no difficulty in re-writing all our results in terms of adsorption.

Yet, when the latter view is considered in detail, it receives somewhat rough handling: “If we adopt Langmuir’s views of oriented adsorption, all sorts of things become possible”—but “such a suggestion is of very little value unless it can be made definite . . . it may well be that some entirely different hypothesis will prove necessary . . . for the moment it looks as though the organic chemist were the safer man to follow . . . the identification of the intermediate compounds does not account for the catalytic action. On the other hand, it is impossible to take the next step until the intermediate compounds have been identified.” This, in sporting language, looks like backing each theory both ways; at the same time the Committee concludes that the difference between what is meant by those who talk of “definite” or “indefinite intermediate compounds,” and those who refer to “adsorption” is “psychological and not chemical.”

The possibility of explaining catalysis by means of the kinetic theory of molecular collisions—the function of a catalyst being then in some way to increase the opportunities for collisions of molecules, perhaps in specific positions, is considered in some detail, but the Committee is apparently inclined to the view that on the whole “activation by adsorption” affords a better explanation. The vagueness of what is implied by “activation” is fully appreciated by the Committee, as may be seen from its reference to Baly’s hypothesis on “opening up fields of force,” but it seems to feel that Langmuir’s theory of “oriented

¹ Proc. Roy. Soc., 1920, 98A, 37

adsorption" offers the possibility of an explanation of the supposed activation, for the last word is a suggestion that Langmuir's theory would throw more light on the real problem of contact catalysis if it were developed so as to show, for example, that an ester was adsorbed in different ways by different catalytic agents, and that the reaction took place at the point of the molecule "where the ester tied on to the adsorbent, forming the indefinite compound."

Whether this is psychological or etymological difference, it is perfectly plain that the Committee's final conclusion, the Langmuir theory of adsorption, in so far as it applies to catalysis, and our own intermediate-compound theory, all come to the same thing. Frankly, we are tiring of etymological splitting of hairs in this matter. Organic chemists will always regard these things from their own standpoint, and so will physical chemists or pure physicists; but what we maintain is that in recent work on catalysis the "adsorption" school of physicists and the "intermediate-compound" group of organic chemists have developed theories which are on closely converging lines, and we suggest that the next move is a definite acceptance of this fact by both sides, followed by mutual exchange of views to facilitate further progress. If the organic chemist, for example, were to state frankly the details which do not at the moment fit in closely with his point of view, and mutual examination of temporarily irreconcilable data were undertaken by representatives of the chemical and physical views from their respective standpoints, it is more likely that progress would be resumed than if the apparently interminable discussion on terminology were pursued further.

The reluctance of some chemists (we had almost written catalytic chemists) to have anything to do with chemical compounds, however unstable, is hard to understand, but is well illustrated by the Committee's failure to grasp why, if the dehydration of alcohol by alumina depends on the intermediate formation of aluminium ethylate, kaolin should act almost as well as alumina, since "the formation of a definite kaolin ethylate seems improbable." Now, surely it is common knowledge that kaolin and the many other complex silicates and aluminosilicates, although definite in one sense, are indefinite in that various molecular proportions of the constituent oxides may be found combined together and *may act to some extent independently of the total molecule as such*. Thus, in some other complex silicates, the zeolites, it is actually and readily possible to replace some of the bases by others, for example, soda by lime, and *vice versa*, without affecting in any way the aluminosilicate part of the complex. Since then the complex silicate molecule is so flexible that part of it can be chemically interchanged without dis-

rupting the whole, it is equally possible for the alumina in kaolin to carry on transient combination with alcohol without affecting the rest of the kaolin molecule. The phenomenon of base-exchange in the zeolites is a particularly beautiful analogy of the ease of intra-molecular chemical interaction which, although non-catalytic, should be borne in mind before dismissing too lightly the probability of intermediate-compound formation during catalysis.

The action of "promoters" is dealt with briefly in the report, reference being made to Pease and Taylor's summary of the data on this branch of the subject.² Whilst quoting Rideal and Taylor's supposition that the promoter alters the proportion in which the interactants are adsorbed at the catalyst surface, the Committee adds an alternative suggestion, namely, that perhaps the catalytic agent activates only one of the reacting substances or activates one chiefly, whilst the promoter activates or increases the activity of the other. The subject of promoter action is, however, so complicated and obscure that a considerable amount of further detailed experimental work is necessary before a general explanation is likely to be discovered. It is shown that the theory of poisoning of contact catalytic agents has been more satisfactorily developed. Any substance which retards, or prevents, the approach of the reacting substances to the catalytic agent will slow down or put an end to the reaction; or, the poisoning of a catalytic agent is due to marked adsorption, which cuts down the adsorption of the reacting substances.

The recent work of Taylor and Burns,³ of Maxted,⁴ and of others is fully discussed and the evidence for the above views concisely summarised. An interesting point is made when it is remarked that "poisoning" of non-catalytic reactions is a familiar phenomenon in the non-corrosion of many oxidisable metals due to a minute protective film of oxide. In this connexion we would draw attention to the unfortunate manner in which physico-chemical theory lags behind technical practice in the realm of catalytic action. It is no secret that, as in other technical applications of catalysis, the matter of "poisons" was one of the greatest difficulties connected with fat-hydrogenation. These difficulties were overcome in works' practice ten years ago mainly by consideration of the possibility of "films" of various kinds preventing contact between catalyst, oil and hydrogen, although the blessed word "adsorption" was not specifically invoked, even though it had by that time been invented.

Rosenmund's⁵ employment of suitable "poisons" to modify the action of catalysts

² J. Phys. Chem., 1920, 24, 241

³ J. Amer. Chem. Soc., 1921, 42, 1285

⁴ Maxted, J. Chem. Soc., 1919, 115, 1050; 1920, 117, 1280, 1501; 1921, 119, 225

⁵ Ber., 1921, 54B, 435, 638, 1002

is referred to, and this seems to be a field of which the potentialities are by no means yet fully explained.

Other subjects which are dealt with are the mixed oxidation catalysts devised by Lamb, Bray and Frazer,⁶ Rideal's attempted connexion between overvoltage and catalytic power,⁷ and the apparent stimulation of some catalytic hydrogenations by small quantities of oxygen.⁸

Whilst the report gives a very full account of the present knowledge of the procedure of contact catalysis, we feel that the lines on which

further work is apparently recommended to be undertaken are somewhat restricted in scope. In our opinion more attention should be paid to the characteristic side actions which proceed during most cases of catalysis.

Although we have handled the report critically, we do not wish in any way to detract from its great value at the present juncture. The more fully and frankly such problems are discussed the better for chemical progress; all hypotheses are of value provided they are put to the test of experiment and even in catalysis an ounce of practice is worth a great deal of theory. The thanks of all chemists are due to Prof. Bancroft and his colleagues for the labour they have expended on their report.

⁶ J. Ind. Eng. Chem., 1920, 12, 217

⁷ J. Amer. Chem. Soc., 1920, 42, 94

⁸ Willstätter & Waldeschildt-Letz., Ber., 1921, 54, 113

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

THE sixth annual report of the Association covers the most difficult period, from the trade point of view, which has yet been experienced; but, despite the adverse circumstances, the Association has firmly maintained its numerical strength, improved its finances, and established its position.

For the first time in the history of the Industry a thoroughly representative chemical exhibition was organised by the Association as a section of the British Industries Fair, held at the White City early in 1922. The exhibition created great interest, both in trade and official circles, about fifty members of the Association participated, and although, as was to be expected, they were not overwhelmed with orders, a certain amount of business was done; the real value of the exhibition lay in the education of the public mind as to the scope and possibilities inherent in British chemical industry.

The revision of the Association's Directory has proved to be more complicated and difficult than was anticipated. The Russian and Japanese languages have been replaced by German, and the lists of products and proprietary trade names have been extended. The publication should be ready for distribution at an early date. During the year the Association's pamphlet on "British Research Chemicals" was revised and greatly enlarged to cover about 1800 fine-chemical products, including inorganic chemicals, indicators, and microscopic stains; many thousand copies were distributed to chemists, Trade Commissioners and others interested, in all parts of the world. Information concerning the industry has been contributed to the Press throughout the year, and the public has been kept informed of the progress of the industry.

The Council, having felt that the time had come when an effort should be made to get the terms of contracts with public authorities so amended as to be just and reasonable to both the contracting parties, approached the Federation of British Industries, and this body has set up a committee for the purpose of revising the conditions of forms of contract, tender and specifications in use by

Government departments, municipalities and other public bodies. Mr. H. Fergusson represents the Association on this Committee.

Since the conclusion of the war many countries have revised their customs tariffs, and those of Spain and the United States have in particular engaged the attention of the Council. Mr. R. G. Perry has represented the Association on the advisory board nominated by the Federation of British Industries to assist the Board of Trade in its negotiations with the Spanish Government.

Much useful work has been carried out by the Joint Research Committee of the Association and the British Chemical Plant Manufacturers' Association, and an understanding has been reached with the British Engineering Standards Association whereby overlapping of activities will be avoided; the latter Association has issued a Directory, which supplies a long-felt want. The report on the Standardisation of Steam-Jacketed Pans (*cf.* J., 1922, 52 R) aroused great interest throughout the industry, and its excellence is shown by the adoption of the specification by the British Engineering Standards Association as the official British standard. A similar report on standard covers for jacketed pans will be issued shortly. Preliminary reports on the standardisation of cast-iron filter-presses have been issued for criticism (*cf.* J., 1921, 401 R, 1922, 210 R), and the final report is nearly ready for publication. The use of nickel, Monel metal and chromium steel in chemical plant has been investigated.

The Association has taken a sympathetic interest in the inauguration of the Institution of Chemical Engineers, of which the General Manager is vice-chairman. This new organisation should be of considerable benefit both to chemical and plant manufacturers.

Throughout the year the Council has been constantly engaged on the problem of transport. The Railways Bill, which received the Royal Assent in August, 1921, is of great importance to the chemical industry in that, for the first time in the history of railways, it takes away from the railway

companies the power of finally deciding what are dangerous goods and invests it in the Railway Rates Tribunal. Further, the rates charged on dangerous goods are in future to be subject to analysis in precisely the same manner as the rates for ordinary merchandise, so that chemical manufacturers will not have to pay for services which are not provided, as hitherto.

Apart from the Railways Act, the Traffic Committee has been fully occupied in dealing with the consequent revision of the General Railway Classification of Goods. Many objections were sent in by various members to the proposals of the railway companies in connexion with the classification of non-dangerous goods, and as the result of meetings held with the companies a number of concessions were obtained (*cf. J., 1922, 73 R*). It was, therefore, only necessary to ask the Rates Advisory Committee to adjudicate upon 20 cases, with the result that decisions favourable to members were given in no less than 15 cases. It is fair to say that no other industry received more concessions than were obtained for the chemical industry.

The classification of dangerous goods has entailed much detailed work by the Traffic Committee, as that body formed the nucleus of the Dangerous Goods Sub-Committee of the Traders' Co-ordinating Committee. The proposals of the railway companies consisted of 49 foolscap pages of printed matter, and some 150 objections were lodged. The Committee has held meetings with the railway companies extending over six days, and the result is that the Rates Advisory Committee will only be called upon to adjudicate in about 30 cases. The work of the Association, through its Traffic Committee, will lead to a very substantial saving in the cost of rail transport when the new rates and charges come into operation.

The railway companies have recently submitted their new general conditions of carriage for the approval of the Railway Rates Tribunal, and these proposals are being carefully examined in conjunction with other traders' organisations, in order that the interests of members may be fully protected. The Council has associated itself with the Federation of British Industries in opposing the Bill presented to Parliament by the North-Western and Midland and West Scottish Group of Railways asking for powers to enable the group to become carriers by road.

In December, 1920, the Home Office circulated a draft of proposed new regulations for factories and workshops. The original draft was severely criticised by members of the Association. The Council took the matter up and, after protracted negotiations, secured the issue of an amended draft, in which all the points raised by the Association were given the fullest consideration.

The Council has also considered the bearing of the following Parliamentary measures upon the interests of chemical manufacturers:—Rating of Machinery Bill, Salmon and Freshwater Fisheries No. 2 Bill, Alkali Works and Registration Acts 1906, Safeguarding of Industries Act, and the Dyestuffs (Import Regulation) Act. In connexion with the last-named, a committee has been appointed to inquire what action, if any, the Council can take to promote co-operation among the interests involved, so as to cheapen the cost of dye production in this country.

THE ANNUAL MEETING

The sixth annual general meeting was held in Burlington House, London, W., on July 13.

Sir John Brunner, Bart., presided, and in moving the adoption of the Report said:—The Association is to be highly congratulated upon the fact that it has secured the services of Mr. Woolcock upon mutually satisfactory terms for a further period of five years. Mr. Woolcock is, to a very large extent, the Association, and we cannot do without him.

There is acute difference of opinion in this country whether a tariff is good for our country or whether it is not; but I think we are all agreed that a tariff in a foreign country is not a good policy, and, unfortunately, since the war all the countries of Europe have set up almost prohibitive tariffs which have done a great deal of mischief in retarding the revival of trade. A new proposal has been presented to the United States Senate, not only with regard to tariffs, but with regard to subsidising the American shipping industry, and I am very pleased to see in the Press that they have found very great difficulty in carrying this almost prohibitive Fordney Bill, and that apparently the whole matter is again going to be dropped, as it was last year. We will, I am sure, keep our eyes upon this matter, and if anything can be done by the Council to mitigate the operation of the American tariff, I am certain the Association will do it.

In the matter of transport we are greatly indebted to Mr. Malacrida and his department. You will have seen in the papers this morning that the railway rates in this country are shortly to be reduced to 75 per cent. above pre-war figures, instead of 100 per cent., and the flat-rate increases are to be reduced from 1s. to 6d., from 9d. to 4d., and from 6d. to 4d. per ton, the flat rate of 3d. being unaffected. The rate for small parcels is to be reduced from 150 per cent. to 100 per cent. I would like to bring to your notice a sentence in the Report which says: "The constant bringing together of industrialists and railway officials has created a new atmosphere, and the relations between them are now on a very satisfactory footing," which is, I think, a great deal more than can be said of the relations of traders and railway companies in the past. It says a great deal for the tact of our officials who have been able to create this friendly feeling with the railway companies. It not only saves traders a great deal of expense but also the railway companies, and if both sides get what they want without expense it always tends to the reduction of rates.

With regard to the Home Office Regulations under the heading "Dangerous and Unhealthy Industries," a term which I personally object to, because there are a great many chemical operations which are no more dangerous to health or to life than working in a cotton factory or even sitting at a desk in the Home Office, I think it is begging the question to call the whole of the chemical industry a dangerous and unhealthy industry. It is one of the difficulties under which legislation of the present day labours that Parliament is so overwhelmed with work that regulations of this character have to be left to the various Departments. However, we have succeeded in this instance in arriving at an agreement with the Home Office which, although it is not entirely satisfactory to us,

is one in which we can acquiesce, and one which has practically entailed no expense to the chemical industry of the country.

I think you can be very highly congratulated upon the continued usefulness of this Association to the trade of chemical manufacturers in this country, and so long as the members of the Council continue to work in entire harmony, that state of things will persist. In founding this Association I think that we have done a great stroke of work for the chemical industry, and I trust it will be as prosperous in the future as it has been in the past.

The motion for the adoption of the Report was seconded by Mr. Max Muspratt (vice-chairman).

In the subsequent discussion Dr. E. F. Armstrong said that the subjects of tariffs, licences, and of the whole mechanism of safeguarding industries were extremely complex but unfortunately brought in politics. Those who believed that any other policy than that of Free Trade led to destruction had been able in the case of the chemical industries to sacrifice that view for the greater end of establishing the chemical industries of this country. The heavy chemical industry had, fortunately, perhaps partly for geographical reasons, been able to stand on its own. The dyestuff and fine-chemical industries had found themselves in a more difficult position. To have an industry of that type there must be trained technical men to carry out the work. The most brilliant finance, the most original and remarkable organisation, and even cheap transport were all unavailing in the absence of technical ability, but he felt sure that such ability was plentiful in this country. The chemical industries were of national importance, not only for the products they gave and which surely should be made in this country rather than be brought from abroad, but as training grounds for chemists, the chemist being regarded as a very important servant of the State. If they reviewed the technical men holding more or less responsible positions throughout British industry, ignoring those who were connected with the heavy chemical industry, they would find a great many came out of one or two industrial schools, possibly out of the laboratories of a firm like Nobel's, and the necessity of having such industrial schools was obvious. Unless we established our fine-chemical industry and our dye industry we should have no industrial schools in which to train those chemists who would be at hand in the hour of need, whether in peace or in war.

Mr. E. V. Evans said he thought they must face the fact that the Dyestuffs Act did not afford the measure of protection that the industry really required. That Act was designed to promote the dye industry without prejudice to the textile industry, a matter which Euclid would have shown to be entirely absurd. They would remember that in order to assure that the interests of the textile industry should not be adversely influenced during the growth of the British dye industry, the Act provided that the representatives of the users should be in a majority on the Licensing Committee. The users had not taken undue advantage of their numerical superiority, but the fact was that they possessed this potentiality. Were it not that they were men honestly desiring the dye industry to be harboured in this country, the position would be an impossible one. The question of price was at the moment acute. The position was that if a

consumer of dyes could show that he had to pay more than three times the amount for his British dye than he paid for his foreign dye before the war, that was sufficient justification for the importation of the foreign dyestuffs, provided, of course, that the foreign dyestuff was itself sold at a figure which was not more than three times the pre-war foreign price. This factor of three was an exceedingly serious matter to the dye industry at the present moment. He could well understand that some simple colours could be made at this price, but he was certain that the whole dye business could not be worked on that basis, and it was even more impossible to imagine that new ventures could be undertaken with this price factor in operation. It would be a totally different thing if the sales of the dye industry and the output of plant were normal. They had been forced to the conclusion that the best way to resuscitate business in this country was to labour temporarily under this disability; although their representatives had fought strenuously against the acceptance of the price factor, they had been forced to accept it for the present.

Dr. Seligman referred to the work of the Joint Research Committee of the Association and the British Chemical Plant Manufacturers' Association, of which he is chairman. He said that there had been a tendency in the past to standardise everything, irrespective of whether it was amenable to standardisation or not, and the Committee had put the brake on where it was felt desirable, and had probably contributed to more practical results in that way. The Joint Committee had before it a suggestion that it should undertake an investigation into the education of engineers for chemical works. Many members of the Committee hesitated to accept that task. They were not unanimous on the subject, and he thought if it were possible for some of the leading members of the Association to express their views whether it was desirable that the Committee should deal with this subject, it would be a great help to the Committee in reaching a decision. The whole question bristled with knotty points, and many were frankly afraid of it. Members of both the Committee and the Sub-Committees, which it had formed, had worked extremely hard, but he felt that they wanted a little more inspiration than they were getting. If only the members of the Association could give them more problems to tackle, more things which they could look into in a preliminary way, he would feel happy about the future utility of the Joint Committee.

Sir William Pearce said he was afraid that neither the nation nor the House of Commons really realised the enormous importance of synthetic organic chemistry and the great future before it in dyes and fine chemicals. He supposed they would be suspect if they went in for propaganda, but outside and inside the House of Commons the importance of these two branches of their industry was really not properly recognised, and it was a question of education. The dyestuff and fine-chemical industries would be the two great industrial successes of the future, and no nation could afford to do without them. If that view were instilled into the minds of the public and of Parliament the two industries could be secured. The Germans took that view. He had had a remarkable interview with one of the directors of the German "I.G.," who told him that the German Government

and people regarded synthetic organic chemistry as the best asset they possessed and the best hope they had of recovering commercial prosperity or supremacy. That was not realised in this country. It would be a good thing if the Council could put the facts of the progress of these industries before the public. It would be welcomed by the members of the House of Commons, very few of whom really understood the great importance of those two industries. They complained to him of lack of information; they did not know the progress of these industries or understand the difficulties, which were stupendous to-day, because not only had they the enormous combination of the German I.G. to contend against, but they had to meet an unexampled slump in the textile trade.

The Rt. Hon. J. W. Wilson said he thought that one of the most important pieces of work during the year was that done at the British Industries Fair. He thoroughly agreed that they had a good deal to learn from Germany both in unifying interests in different chemical manufactures and in educating the public and, indirectly, the buyers. He was satisfied from what he saw of the Fair that it did a great deal of good in educating the public and in bringing the members and staffs of the various chemical firms and manufacturers together to compare notes and realise that more could be gained by interchange of views than by following the traditional British attitude of looking suspect on everybody who asked a question. He thought there was a great deal more to be done by cultivating friendly relations between buyer and seller than in artificial or temporary barriers and hindrances.

The resolution was adopted and Messrs. Feasey and Co. were reappointed auditors for the ensuing year. Mr. T. Miller-Jones presented the report of the scrutineers, which was received and adopted.

A special general meeting of the Association then followed, at which the Chairman moved and Sir W. Pearce seconded a resolution to reduce the amount of the annual subscription payable by members by 20 per cent. for the year 1922-23. This was carried unanimously.

The meeting terminated with a vote of thanks to Sir John Brunner for his services as chairman during the past two years.

SAFEGUARDING OF INDUSTRIES ACT

SODIUM HYPOSULPHITE "R"

On July 7 and 8 Mr. Cyril Atkinson heard the complaint of R. W. Greeff and Co., Ltd., that "sodium hyposulphite R" had been improperly classified among the articles dutiable under Part I. of the Act. The United Alkali Co., Ltd., and the Board of Trade opposed the complaint.

In his opening speech, Mr. K. Swan, counsel for the complainants, detailed the uses of sodium thiosulphate and then referred to the counter-statement of the Board of Trade, according to which this substance is no longer made from alkali waste but by the action of sulphur dioxide on sodium sulphide, and by boiling sodium sulphite solution with sulphur. None of these processes can be described as fine-chemical. The Board intended "sodium hypo-

sulphite R" to include the substance used for photographic and analytical purposes, which is undoubtedly a fine chemical, being made by fine-chemical manufacturers and classified as such by the Association of British Chemical Manufacturers. The "commercial" quality is less pure and is sold at prices about 50 per cent. lower than those of the "R" quality.

Mr. Swan said his case was that the methods of manufacture were not fine-chemical methods; sodium thiosulphate was used only in negligible quantities as an analytical reagent; it was a well-recognised heavy chemical and made by heavy-chemical manufacturers; the purest qualities were used for industrial purposes (chiefly photography and tanning); and that it was not an analytical reagent within the meaning of the Act. Most of the material consumed in this country came from abroad and was marketed in 1-10 ton lots. He contended that the degree of purity of a substance could not determine its classification as "fine" or "heavy," and that the Board of Trade was not justified in affixing "R" to an admittedly heavy chemical. The "pea" crystals of "hypo" used in photography were not purer than the "commercial" quality.

Evidence for the complainants was given by five trade witnesses, all of whom maintained that there was no appreciable difference in quality between the pea crystals and the larger crystals known as "commercial," and that the difference in price (about £3-£4 per ton) was mainly accounted for by the different methods of packing. Importation, which was large before the war, had practically ceased since the Act came into force.

In reply to Sir Arthur Colefax (counsel for the United Alkali Co.), who adduced prices of £12 10s. and £18 a ton for the two grades quoted in a trade journal for May 5, 1922, Mr. A. H. Gilbert, a chemical dealer, said that price quotations in all the trade papers were most erratic. It was only extreme folly which made purchasers pay the higher price for what was substantially the same article. A great deal of the "hypo" he had sold came from Germany. The term "hypo, photographic" was not recognised by dealers.

Mr. A. F. Butler, director of R. W. Greeff and Co., also affirmed that sodium thiosulphate was regarded by the trade as a heavy chemical. In his firm's price-list it was classified both under "technical" and "photographic" chemicals. When both forms (pea and large crystals) were packed in the same manner, the difference in price was only about 12s. 6d. per ton. Asked by Sir A. Colefax why "sodium hyposulphite, Rhodia brand," was priced in his firm's list of January, 1922, at 20s. per cwt., and classified, not under "Technical Chemicals" but under "Fine Chemicals and Pharmaceutical Products," witness said that Rhodia crystals were a special brand; the list was the only one issued to heavy-chemical manufacturers at the present time, and it contained other heavy chemicals, e.g., oxalic and citric acids.

Mr. R. J. Kindon, of Chas. Zimmermann and Co., (Photographic), Ltd., quoted trade journals in which "hypo" was referred to as a heavy chemical. For about 20 years his firm had sold the "Agfa" brand, which was made by the A.-G. für Anilinfabrikation, of Berlin. The qualities demanded of photographic "hypo" did not include very great

purity, but great whiteness, clearness, regularity of size of crystals, and freedom from dust.

Mr. O. F. C. Bromfield, secretary of the British Chemical Trade Association, said that he compiled the London market reports in the *Chemical Trade Journal*, and he contributed market news to the *Chemist and Druggist*, but in the latter case he was not responsible for the classification adopted. He had only been connected with the chemical trade since 1919, and he obtained his information from merchants, not from manufacturers. The classification he adopted was based on trade custom, and he regarded the terms "industrial" and "heavy" as substantially synonymous, and also the terms "fine" and "pharmaceutical."

Mr. E. J. Parry said that the pea crystals and the large crystals were practically identical in chemical composition; he had never seen a sample of "commercial" hypo of less than 98.5 per cent. purity, and the average difference in purity between the two forms was about 0.5 per cent. There was a third form, purified by repeated crystallisation, which was sold at about 2s. 3d. per lb., but it was quite a rarity; its use as an analytical reagent was foolish, because the "commercial" form was as good as the best for that purpose. Its use for analytical work was so small (a small fraction of 1 per cent. of the entire consumption) as to be negligible. Sir A. Colefax mentioned analyses covering 12 years, supplied by the United Alkali Co., and showing that the purity of the commercial quality varied from 93.79 to 97.46 per cent. Mr. Parry said that English manufacturers produced an article analysing 98 to 99 per cent. He admitted that sodium thiosulphate was an analytical reagent in common use and that many important industrial analyses depended upon it. In common with many other photographic chemicals, it was not a fine chemical. The Continental fine-chemical manufacturers who made and sold it, probably did so to keep their trade in photographic chemicals together.

Mr. Whitehead, for the Board of Trade, said that "hypo" of photographic quality was a perfectly well-known commodity. Before the Act came into force, the pea quality was the photographic quality, and would still be if properly and genuinely prepared; but it was now being imported in an impure state, in order to avoid duty.

Sir A. Colefax argued that the words in the Act "analytical reagents, all other fine chemicals," implied that all analytical reagents were fine chemicals. The use in photography of an admittedly heavy chemical justified its classification as a fine chemical, because it was of the definite degree of purity demanded for that purpose. Those who sold the pea quality for photographic purposes were impressed by the necessity for special tests. But there was no need to discuss the claims of "hypo" to be regarded as a fine chemical because it was admitted that the pea quality was a typical, well-known and widely-used analytical reagent.

Mr. E. B. Cook, managing director of Johnson and Sons, Manufacturing Chemists, Ltd., said that his firm sold practically only the fine pea form and the cubic crystals, both of photographic quality. These crystals were clear, of good colour (not yellow), free from moisture, and always analysed over 99 per cent., usually 99.5 per cent. and upwards; any material below 99 per cent. was rejected.

Mr. Swan expressed the opinion that "analytical reagents" meant those analytical reagents which were fine chemicals. Mr. Whitehead said that the view of the Board of Trade was that every analytical reagent was a fine chemical.

The Referee's award, signed on July 17, was as follows:—

Sodium hyposulphite is put on the market in two forms and under two descriptions. There is the ordinary quality known as commercial, which is in the form of large crystals of different shapes and sizes. There is no standard of purity or colour to which it is expected to conform. There is also the quality known as "pea crystals." The material is in the form of small crystals uniform in shape and size. Again there is no fixed standard of purity or colour to which it must conform, but it is expected to be clear, dry, and a very good white. In practice analysis shows that the percentage of purity varies from 99 to 99.5 per cent. At times even a higher degree of purity is obtained. The material is very largely used in photography, and the demand for this purpose has led to the introduction of the description "photographic quality." That description implies that the material is of the highest quality put on the market. To answer that description the material must be in the small crystal form, of very good colour, dry, and of a purity not less than 99 per cent.

There is no dispute but that sodium hyposulphite is an analytical reagent. It is in common use. It would find a place in any list of analytical reagents. The quality used for this purpose is the best obtainable, i.e., the photographic quality.

Sodium hyposulphite has been included in the list published by the Board of Trade with the letter "R" against it, meaning thereby that only the highest quality, viz., the photographic quality, is to be dutiable under the Act. This inclusion in the list is justified by the Board of Trade on the ground that sodium hyposulphite of photographic quality is (1) an analytical reagent and/or (2) a fine chemical.

The complainants concede that it is an analytical reagent, but deny that it is a fine chemical. They contend that as a matter of construction the words in the Schedule only include such analytical reagents as are fine chemicals. They rely strongly on the word "other" in the Schedule. The relevant words to be construed are "synthetic organic chemicals, analytical reagents, all other fine chemicals."

I do not see how the complainants can be right. To hold that synthetic chemicals and analytical reagents are in the Schedule only if they are fine chemicals, quite apart from their claims to that description as being synthetic in the one case or analytical reagents in the other, would be to give no effect to the words preceding "all other fine chemicals."

Some weight must be given to the word "other," and in my opinion the interpretation which gives effect to all the words used is this:—The Legislature intended to protect the fine chemical industry, but the expression "fine chemical" was very vague. It was without any definite meaning. The Legislature deliberately avoided attempting to define fine chemical, but it intended that there should be no mistake about the inclusion within that phrase of synthetic organic chemicals and analytical re-

agents. The specific inclusion of these chemicals indicates in my opinion that the words "fine chemicals" were intended to be used in a sense wide enough to cover the classes mentioned. Parliament was content to leave the further application of the expression "fine chemicals" to the Board of Trade, and to a Referee, but their hands were to be tied in respect of such chemicals as could with reasonable certainty be described as synthetic organic chemicals or analytical reagents.

As this view seems to me the right one I thought it unnecessary to determine whether or not sodium hyposulphite was a fine chemical independently of its being an analytical reagent.

In my opinion, once it is conceded that sodium hyposulphite is an analytical reagent in regular use, the complainants' case falls to the ground, and I have no option but to award that the substance in question in its purest form is rightly included in the list as an analytical reagent. Only the purest form of the chemical is within the Schedule. It is only that form which is used as a chemical reagent.

I think that it is advisable to be a little more definite as to what is meant by the letter "R" in this particular case. It is stated on behalf of the Board of Trade that only the quality known as "photographic" is intended to be included, and I think that it would be wiser to state that in the list.

I wish it to be clearly understood that the mere fact that sodium hyposulphite is in pea-crystal form does not prove that it is of photographic quality. In my opinion photographic quality indicates that the chemical is in the form of small uniform crystals, that it has great purity of colour, and is of 99 per cent. (or thereabouts) purity and upwards. No objection is offered by the Board to the addition of the words "photographic quality."

I therefore award that the list be amended by inserting after the words "sodium hyposulphite" the words "photographic quality." The complaint fails. No order as to costs.

PERSONALIA

Dr. J. C. Drummond has been appointed to the chair of biochemistry at University College, London.

Mr. Max Muspratt has succeeded Sir John Brunner as chairman of the Association of British Chemical Manufacturers.

The honorary degree of D.Sc. of the University of Oxford has been conferred on Prof. J. Perrin of Paris and on Prof. F. Gowland Hopkins of Cambridge.

Mr. S. Pexton has been elected to the gas research fellowship founded by the Institution of Gas Engineers, and Mr. W. H. B. Hall, of the South Metropolitan Gas Co., to the Corbett Woodall Scholarship, both tenable at the University of Leeds.

The Commissioners of the Exhibition of 1851 have awarded a Senior Studentship to Mr. J. S. Buck, research student in chemistry, Liverpool; and on their nomination Mr. D. F. Stedman, University of British Columbia, and Mr. J. C. Smith, University of New Zealand, have been awarded Science Research Scholarships (Overseas) for physical chemistry and chemistry, respectively.

Dr. Lennart Smith has been appointed professor of chemistry in the University of Lund, Sweden.

Mr. L. M. Tolman, chief chemist to Wilson and Co., Chicago, has been elected president of the American Oil Chemists' Society.

Prof. A. Pictet, professor of chemistry in the University of Geneva, has been elected a corresponding member of the French Academy of Sciences.

Prof. C. H. Warren, professor of mineralogy in the Massachusetts Institute of Technology, is to succeed Mr. Russell H. Chittenton as director of the Sheffield Scientific School.

Mr. H. G. Tanner, chief chemist at the Experimental Potash Plant, Summerland, Cal., U.S.A., has been appointed to a professorship of chemistry in the University of Oregon.

Dr. Max Volmer, extraordinary professor in the University of Hamburg, has been appointed ordinary professor of chemistry in the Berlin Technical Hochschule. Professor M. Volmer has been appointed professor of physical chemistry and director of the Institute of Physical Chemistry in Berlin. Doctors A. Gutbier and R. Stoermer have been appointed to the chairs of chemistry in the Universities of Jena and Rostock, respectively.

NEWS AND NOTES

UNITED STATES

The Sequestrated German Patents

President Harding has ordered the Alien Property Custodian to demand the return of the sequestrated German patents that were sold to the Chemical Foundation, Inc. The demand, which affects 4000 patents and other property, is said to be based on the ground that the German patents were sold at prices insufficient to protect the interests of the former German owners for whom the Alien Property Custodian acts as trustee. The patents were sold in 1919 to the Chemical Foundation for \$250,000, but their value is problematical, as the policy of the Foundation has been to issue non-exclusive licences for working them; and it is also said that less than 2 per cent. of them had been found of use. Mr. Francis P. Garvan, president of the Foundation, stated in an interview that the action was taken without giving any notice to the United States organic-chemical industry or to the Chemical Foundation, and was begun, so he was informed, after the representatives of the German "Interessengemeinschaft" and the German Government, but not American interests, had been heard by the United States Attorney-General. It is stated that the demand will be refused and the issue decided in the District of Columbia Court.—(*Oil, Paint and Drug Rep.*, July 10, 1922.)

Lethal Gases for Exterminating Pests

Experiments on the use of poison gases for exterminating obnoxious birds, rodents and insects are to be undertaken in the autumn by the U.S. Chemical Warfare Service and the Biological Survey. Chlorine, when handled properly, has already given good results against "pocket gophers" and ground squirrels, and phosgene has

been used successfully against rats in Porto Rico. The effects of various gases on the insect pests of growing plants and stored grain have been tested, but a substitute for hydrogen cyanide or carbon bisulphide has not yet been found.

Stone in 1919

The U.S. Geological Survey states that about 65,539,000 short tons of stone was sold in the United States in 1919, or 4 per cent. less than in 1918 and 22 per cent. less than in 1917. A total of 21,315,300 t. of limestone and marble was sold as furnace flux, 1,060,741 t. of ganister (quartzite), mica schist and dolomite as refractory stone, and 4,370,936 t. for other industrial uses. The industrial consumption of limestone was as follows:—Alkali works, 2,215,660 t.; sugar factories, 503,835 t.; glass factories, 166,106 t.; paper mills, 92,421 t.; agriculture, 1,392,914 t. In addition, 864,441 t. of limestone was sold as a filler for asphalt, paint, rubber, soap, for making basic magnesium carbonate, to alcohol and calcium-carbide factories, and for making refractories.

FRANCE

Industrial Notes

Chemical Industry.—The chemical market is firm and the demand for sulphuric acid and for fertilisers is brisk. The price of sodium nitrate tends to rise, but that of ammonium sulphate has declined to 90—92 fr. per 100 kg. There is a keen demand for cyanamide, owing to the fall in price, and most of the cyanamide factories will be occupied for some weeks ahead. Prices of turpentine oil remain firm but may increase as there is a good demand from London and supplies are not coming from the United States. The demand for synthetic perfumes has improved slightly, but the prohibitive prices of the natural products are not conducive to business. The weather remains favourable for the next sugar-beet crop, which is estimated at 500,000 t., i.e., 200,000 t. more than last year's crop.

CANADA

Production of Chemicals

According to a return of the Dominion Bureau of Statistics the production of chemicals and allied products in Canada for the years 1919-20-21 was valued as follows:—\$91,000,000, \$118,000,000 and less than \$76,000,000. The following is a summary of the principal statistics for the three years:—

	1919	1920	1921
Plants	425 ..	450 ..	442 ..
Capital	\$109,268,000 ..	\$116,056,000 ..	\$106,525,000 ..
Employees ..	14,046 ..	16,526 ..	12,139 ..
Salaries and wages	15,948,000 ..	21,143,000 ..	15,463,000 ..
Cost of materials..	47,216,000 ..	58,754,000 ..	35,148,000 ..

Platinum, etc. in Northern Ontario

There has recently been discovered at Shebandowan Lake, Northern Ontario, an interesting occurrence of a nickel-copper-cobalt mineral relatively rich in the metals of the platinum group. The above lake is situated 70 miles west of Port Arthur, Ont., and five miles north of the Canadian Northern Railway. Some of the massive ore carries 8 to 12 per cent. of nickel, and the average rocky material, not hand-sorted, about 6 per cent. nickel, copper and cobalt. The analysis of a sample submitted to the Geological Survey, Ottawa, gave 16 oz. of platinum metals to the ton, and iron, 24.8%; nickel, 3.3%; copper, 5.5%; and sulphur, 20.6%.

Pulp and Paper

The Belgian Industrial Co. at Shawinigan, Que., is extending its paper mill at a cost of \$1,500,000 to \$2,000,000, exclusive of the cost of machinery.

The plant of Kaministiquia Pulp and Paper Co., at Port Arthur, Ont., has been sold to the Consolidated Water Power and Paper Co. of Wisconsin Rapids, Wisconsin. The mill makes ground wood-pulp.

Production has been started by the International Paper Co. at its new plant located at Three Rivers, Quebec. When in full operation the plant will have a daily output of 384 tons of paper.

Construction upon the large pulp and paper mills at Prince George, Northern British Columbia, was due to begin in June. Initially the capacity will be 150 tons daily, but provision is being made to increase the output. The company, to be known as the Bathurst Co., Ltd., has an initial capitalisation of \$3,000,000. Over 200 sq. miles of timber land have been secured east of Prince George, on the Fraser River. The promoters of the company include Lord Beaverbrook, Sir Chas. Gordon, Montreal, Mr. Frank Jones, president of the Canadian Cement Co., Peck Bros., Pennsylvania, and others. Angus McLean, of Bathurst, N.B., is president.

Metallurgical Industries

Nickel.—The mines and smelter of the International Nickel Co., at Copper Cliff, Ont., which have been closed down for many months, will be started not later than September 1. The sales of nickel by this company last year were less than in any year since 1904. The new plant at New Hunnington, W. Va., will cost \$3,400,000, inclusive of equipment. The company's plant at Port Colborne, Ont., has restarted operations. Orders have been coming in freely and stock on hand is being depleted. One million pounds of nickel will ultimately be refined monthly. The smelter at Sudbury, Ont., is expected to recommence operations this autumn.

The largest shipment of nickel matte ever forwarded from Northern Ontario was recently sent to the Mond Nickel Co., at Clydach, S. Wales, from its works at Coniston, Ont. The shipment exceeded 1000 tons and the matte contained about 55 per cent. nickel and 45 per cent. copper.

The British America Nickel Corporation, Deschenes, Que., has a large stock of refined metals on hand, and it is questionable if this refinery will operate on any extensive scale this year. The British Government is holder of £3,000,000 "A" income bonds of this concern.

Iron and Steel.—There is a very marked improvement among the factories engaged in the manufacture of iron and steel and their products. A few months ago the majority of these works were working at less than 25 per cent. capacity, but to-day some are in full operation and others are working at half capacity. It is expected that another extension will soon be made to the plant of Baldwin's, Ltd., Toronto, which manufactures tin and galvanised plates. Two mills have been installed since January, making a total of five now in operation. The construction of the \$20,000,000 steel plant at Ojibway, near Windsor, Ont., is being pushed with greater activity.

The plant of the Electric Steel and Metals, Ltd., at Welland, has been sold to a United States

organisation. This plant, which was erected at the beginning of the war to make munitions, has been standing idle since this remunerative business ceased. The new management proposes to convert the plant into a steel rolling mill.

BRITISH INDIA

Forecast of Winter Oilseed Crops

The final general memorandum forecasts the winter-oilseed crops for 1921-22 as follows:—Linseed: acreage 2,993,000, yield 434,000 tons; rape and mustard: acreage 6,104,000, yield 1,142,000 t. Compared with the estimates of the previous year the linseed crop shows an increase in yield of 61 per cent. and the rape and mustard crop an increase of 33 per cent.—(*Ind. Tr. J.*, June 8, 1922.)

GENERAL

The Federal Council

The hon. treasurer of the Federal Council for Pure and Applied Chemistry notifies that the Council has appointed a committee to raise funds for the expenses of the meeting of the International Union to be held in Cambridge next summer, and for the general purposes of the Council, including a nucleus for a fund to provide better accommodation for the various chemical societies. The committee consists of Sir William Pope, Dr. E. F. Armstrong, Mr. E. V. Evans, Dr. S. Miall, Mr. Emile Mond, and Mr. W. J. U. Woolcock.

New Photographic Desensitisers

World-wide interest was aroused by the announcement some two years ago that Phenosafranine, and its slightly more soluble homologue Tolusafranine, could be successfully employed in dilute aqueous solution as desensitisers, their action being so effective as to allow of panchromatic gelatino-bromide emulsions being developed in bright orange light—or even by candle light—without the production of light fog. Both the above-mentioned safranines, however, exhibit an undesirable affinity for animal membranes—a property which led to pronounced staining of the sensitive surface of photographic plates. Somewhat protracted washing was necessary to remove the stain; in fact, the difficulty of removing the dye from emulsion coated on a film base practically ruled the dyes out of court. Research has naturally been directed, therefore, to the discovery of efficient colourless, or at least non-staining, desensitisers, and a gratifying measure of success has attended the work of Dr. E. König, of the Höchst Farbwerke, who has lately (*Phot. Rund.*, 1922, 59, 89; *B. J. Phot.*, 1922, 69, 351) introduced two products, *Pinakryptol*, a mixture of a colourless compound with a small proportion of the green dye issued in the pure state as *Pinakryptol Green*.

The colourless component of *Pinakryptol* is relatively insoluble, a 1:5000 aqueous solution of the mixture being difficult to prepare. If such a solution—of a muddy green colour—be allowed to act for $1\frac{1}{2}$ to 2 minutes, it reduces the sensitiveness of a modern super-speed emulsion to approximately 1-1100th of its original value. As a general desensitiser it thus rivals phenosafranine, showing even more pronounced desensitising powers on orthochromatic or panchromatic emulsions, and, were it not for the drawback that marked alterations in the speed of action of various developers result from

the bathing, *Pinakryptol* would be a most useful desensitiser. Its velocity of action during the desensitisation is not as high as is desirable, and it does not lend itself, therefore, to the method of application in which it is combined with the developing solution, except under "stand" or "tank" development conditions.

Pinakryptol Green, in spite of its strong family resemblance to the basic dyes, is practically devoid of affinity for gelatin, and, because of its relative ease of solution—a 1:500 stock solution being readily prepared in the cold—it is to be preferred to *Pinakryptol*. A 1:5000 solution desensitises in one minute, giving a reduction, in the case of super-speed emulsions, to a value of 1-1500th that of the original sensitiveness. The depression of sensitiveness to the longer wave-lengths is remarkably great, and the green colour of the solution, mechanically retained by the film after the bathing operation, allows of the fogless development of the most highly sensitive panchromatic emulsions, in the comfort of a bright yellow-orange light.

Very slight disturbance of the characteristics of the various developers occurs in the presence of *Pinakryptol Green*; and since, as is also the case with *Pinakryptol*, no destruction of the latent image occurs when this desensitiser is used, an extended application of the process, particularly by panchromatic workers, may be confidently anticipated.

The Colour Users' Association

The report for the year ended April 30 states that the membership is now 240 and that it represents 90 per cent. of the colour consumption of the country. Colours imported under the Peace Treaty are now selected by the Association in co-operation with the Board of Trade and are reserved for purchase by members for 14 days after arrival. By personal applications to the Board of Trade, the Vigilance Committee has secured the removal of certain chemicals from the Schedule to the Safeguarding of Industries Act. The membership had been classified into twelve trade groups, each group comprising members having common interests. Receipts during the year amounted to £3336, and disbursements to £2765, and there is a balance of £6620 in the bank derived mainly from commissions paid by the Central Importing Agency on sales of the Association's stock.

Carbonic Oxide in Tobacco Smoke

Prof. H. E. Armstrong, who is reported to sympathise with the view of King James I that tobacco "is the lively image and pattern of hell," has recently been investigating the carbonic-oxide content of tobacco smoke and the results of his "little experimental excursion" in the laboratories of the South Metropolitan Gas Co. are given in the issue of the *British Medical Journal* for June 24.

Four sorts of tobacco were smoked in a pipe or as cigarettes, which were attached to a gas-sampling bottle from which mercury was allowed to run out in "puffs," and the smoke was found to contain from 4.24 to 10.15 per cent. of carbonic oxide; the smoke from a cigar treated similarly contained 5.8 per cent., but the ratio of carbon dioxide to monoxide was much higher in the latter case. Determinations were then made by Gautier's method, viz., by estimating the monoxide by passing the purified gas over heated iodine pentoxide and

titrating the liberated iodine. The percentage of carbonic oxide was found to vary between 0.6 and 0.875 in cigarette smoke, and between 0.7 and 1.14 in pipe smoke. Rapid smoking considerably increased the content of carbonic oxide.

Prof. Armstrong then resorted to natural smoking—by deputy—the fume from cigars of various qualities and ages being expelled from the mouth into a mercury receiver and then analysed. Under these conditions the average content of carbonic oxide was 4.7 per cent., compared with 2.6 per cent. in smoke obtained by mercury suction, and the ratio of carbon dioxide to monoxide was much lower. The results were little affected by make or quality; closeness of packing and rate of smoking appeared to be the determining factors. Although South Metropolitan gas was found to contain as much carbonic oxide as the smoke of an average cigar, it is not suggested that the one is an economical, or even a hygienic, substitute for the other.

What is a Chemical Engineer?

The Provisional Committee of the Institution of Chemical Engineers has provided a solution of this well-known problem. "The chemical engineer is a professional man experienced in the design, construction and operation of plant in which materials undergo chemical or physical change." This definition is commendably short, but is it sufficiently precise? Are those who design, construct and operate mining-plant or kitchen-ranges chemical engineers? Is conveying machinery within their province? And does "man" in this case include woman?

Artificial Silk in Italy

There are now five artificial-silk factories in Italy, and their total output is about 8 metric tons (? per day). All these plants are in Northern Italy, but a company which owns a factory in Venetia with a capacity of 2 tons, is erecting one new works in Rome and another in Naples. The viscose process of manufacture has entirely supplanted the expensive and dangerous alcohol process, and the necessary wood-pulp is imported from Norway. Whereas imports were formerly considerable, the Italian factories are now well able to meet any normal increase in the home demand, as well as to export considerable amounts. In 1921 the export was 588.8 t., of which 173.9 t. was shipped to the United States.—(*U.S. Com. Rep.*, May 15, 1922.)

New Salt Deposit in Holland

Borings for minerals conducted on behalf of the State have revealed the presence of a deposit of salt at Corle, near Winterswijk. Previous borings in the same district had shown the existence of a deposit at great depths, but it was irregular and discontinuous. The new deposit was struck at a moderate depth—a point of great importance for eventual exploitation. The new deposit is very regular, and it is hoped that potash salts may also be found.—(*Chem. Ind.*, May 29, 1922.)

The German Potash Industry

According to a report of the general meeting of the Burbach potash group, conditions in the potash industry improved considerably during the past year and sales during the first five months amounted to 561,000 tons of potash (K_2O), an increase of 60 per cent. over sales in the same period

of the previous year. Sales of manufactured salts showed the largest increment, but the demand for crude salts was only moderate. Many potash works are now (June, 1922) unable to fill current orders for manufactured products, the demand having been stimulated by the liberal discounts granted to agriculture by the Potash Syndicate and the introduction of special railway rates. These increased summer sales will probably lead to still bigger sales in the autumn. So far it has been possible to keep inland prices low by charging higher export prices, and the attempt of the Government to levy a special tax on the receipts from exports is regarded as dangerous, for such a tax would inevitably result in an increase in inland prices.—(*Deutsche Bergwerks-Z.*, June 23, 1922.)

Wages in the German Chemical Industry

Labour in the German chemical industry is classified under three heads, viz., general workers, technical workers (including laboratory workers, constructional engineers, chemists, and pharmacists), and office workers, each group being organised under a trade union. Of the 350,000 employees in the German chemical industry, 90 per cent. belongs to trade unions. Wages per hour paid to general workers in the Berlin district (where the highest rates prevail) at the end of 1921 were as follows:—Factory hands 8.50 mk., transport workers 8.96 mk. to 9.35 mk., boiler men and machinists 8.65 to 9 mk., labourers 8.70 to 9.10 mk., coppersmiths 9.30 mk.; apprentices 1.50 to 4 mk. The minimum rates are 33 per cent. less than those paid in the Berlin area. In addition, a family allowance of 14.4 mk. per week is made for dependents of the workers.

The average monthly wages of untrained technical workers at the end of 1921 varied from 1092 mk. in the Leipzig district to 1310 mk. in the Berlin district, and workers with technical education but no practical training were paid from 1495 mk. (Berlin) to 1890 mk. (Cologne), trained technical workers from 1650 mk. (Bavaria) to 2542 mk. (Cologne), and managers, industrial engineers from 2084 mk. (Posen, Silesia) to 2600 mk. (Berlin). The agreement controlling the labour conditions of technical and office workers in the Berlin district provides that employees shall be paid according to length of service at rates reaching a maximum in the eleventh year, that the working week shall be 46 hrs., that employees, when ill, shall be paid for 6 weeks and, after 8 years' service, for 13 weeks. A supplement of 100 mk. per month is paid for each dependent of the worker. The working hours per week vary from 45 in Central Germany to 46 in Bavaria and 48 in Leipzig (*cf. J.*, 1922, 26 n).

In May, 1922, wages throughout the chemical industry were increased by 75 to 80 per cent. over those holding in January, in order to compensate for the depreciated value of the mark, and on May 26 the employers and unions agreed to fix wages during June at an average of 23 mk. per hr., 184 mk. per day, 1058 mk. per week, or 4585 mk. per month, the family bonus remaining unaltered. This represents an increase of 100 per cent., but it provides only an approximate evaluation of the wages now paid to each class of workers, as it is not known whether the increase has been evenly distributed among technical, office, and general workers.—(*U.S. Com. Rep.*, June 19, 1922.)

Sugar Production in Czechoslovakia

It is estimated that the sugar-beet crop for the season 1921-22 was 3,475,000 metric tons, and that the yield of raw sugar was 640,000 t., of which 560,000 t. has been refined to white sugar. In 1920-21 the beet crop was 4,200,340 t., and the production of sugar 717,240 t. During the six months ended March 31, 1922, the consumption was 168,835 t. and exports 257,141 t., leaving 262,364 t. on hand at April 1, 1922. Trade in sugar is now unrestricted, but Government control of profits is continued because of the difference between the home and foreign prices. Prices of raw and refined sugar were fixed at 338 and 650 kronen per 100 kg., respectively, during the 1921-22 season, as compared with 79 kr. in 1914-15 (kr.=10d. at par, now about 1½d.).—(*U.S. Com. Rep.*, May 22, 1922.)

Copper in 1921

The following statistics have been compiled by the Imperial Mineral Resources Bureau:—

				Long tons
United Kingdom	Imports	Bars, blocks, etc.	..	84,320
	Exports	Bars, blocks, etc.	..	10,885
Northern Rhodesia	Production	Finished copper	..	106
Southern Rhodesia	Production	Blister copper	..	2,750
	Exports	Bar, blister and ingots	..	3,016
Union of S. Africa	Production			141
		Metal content	..	92
	Imports	Bar, rod, ingot	..	20
South-West Africa	Exports	Ore and regulus	..	183
	Production	Copper, lead-ore	..	72,043
Protectorate	Exports	Copper-matte	..	1,414
	Production			23,867
Canada	Imports	Ore and concentrates	..	1,228
		Blocks, pigs or ingots	..	413
	Exports	Fine copper in ore, etc.	..	4,692
		Blister copper	..	14,767
		Pigs, bars, sheets, etc.	..	1,453
India	Imports	Unwrought copper	..	504
	Exports			77
Australia	Production			10,971
		Refined copper produced in Australia, and metal in blister, matte, ore, etc., exported	..	18,634
	Exports	Refined copper	..	12,082
		Copper in blister, matte, ore, etc.	..	34
				15,296
Belgium	Imports			6,459
France	Imports	Ore and concentrates	..	48,020
		Cement, crude, ingots, anodes	..	1,402
	Exports	Ore and concentrates	..	3,779
		Cement, crude, ingots, anodes	..	22,300
		Ore	..	97
Italy	Production	Metal	..	561
		Ore	..	1,016
Norway	Exports	Crude and refined	..	4,600
Russia	Production	Oro	..	
Belgian Congo	Production			20,978
Madagascar	Exports	Copper	..	4
United States	Production			
		Refinery production from domestic sources		268,300
		Refinery production from foreign sources		142,900
				411,200
	Imports	Ore, concentrates, matte, regulus, coarse, metal, cement, etc.	..	379,428
		Copper content thereof	..	45,803
		Unrefined, block, blister and converter copper	..	76,668
		Refined copper	..	30,915
	Exports	Ore, concentrates, matte and regulus	..	1,744
		Copper content thereof	..	161
	Exports	Unrefined, block, blister and converter copper	..	67
		Refined copper	..	266,124
	Chile	Bars	..	46,938
		Matte	..	310
		Ore	..	47,926
Japan	Production	Copper	..	52,304

PARLIAMENTARY NEWS

HOUSE OF COMMONS

British Dyestuffs Corporation

Mr. Baldwin, replying to Major Barnes, said he was aware of the financial position of the Corporation, but no proposals had been made respecting the Government's holding in it.—(July 10.)

Sales of Coal to Germany

In answer to Lieut.-Com. Kenworthy, Mr. Bridgeman stated he had no information that British coal sold to Germany was being transferred to France as "reparation" coal. During the first half of 1922, 6,616,992 tons of British coal was exported to France and 2,882,655 t. to Germany.—(July 12.)

Applications for Patents

Sir W. Mitchell-Thomson informed Capt. W. Benn that the delay in dealing with applications for patents was largely due to arrears of work caused by war conditions and depletion of staff for military service. Since the war the number of applications had increased to an average of 35,000 yearly, as compared with 30,000 in 1913. Every effort was being made to return to normal conditions.—(July 14.)

Norwegian Cement

Replying to Mr. J. Wilson, Mr. Baldwin stated that the prices quoted during 1921 for bulk consignments of British cement were slightly below the average declared value of imported Norwegian cement. The price of British cement and the average value of imported Norwegian cement had both fallen during the present year, but continued to approximate closely. The Board of Trade had no power to ensure the continued consignment of Norwegian cement to this country.—(July 17.)

Railway Rates

In answer to Mr. Gilbert, Mr. Neal said that the railway companies in England and Wales had announced general reductions in railway rates for goods traffic from August 1. The rates were not fixed for any definite period, but the Federation of British Industries and the companies had agreed not to apply for a general alteration to come into force before July 31, 1923.—(July 17.)

Export Duties in African Colonies

Answering various questions, Mr. Churchill said that the duty on palm oil exported from Sierra Leone had been reduced to 20s. 10d. per ton, which was a little more than 4 per cent. of the price at Freetown at the end of May. Recently the export duties on palm oil and palm kernels in Dahomey were 49·5 francs, and 24·75 fr. per metric ton, respectively, the corresponding rates in Nigeria being £3 and £2 per ton and in Sierra Leone 20s. 10d. and £1 per ton. The export tax imposed on cotton from Uganda was designed to raise revenue for developing the cotton-growing districts; since the tax was applied the export had increased from 6300 tons in 1919 to 14,500 t. in 1921. The reason why it had not paid to export hides and skins from Nigeria was the fall in value of the hides from 1s. 3d. to 5d. or 6d. per lb. and not the export duty, which had been reduced from 2d. to 3d. per lb.

The export duty on cocoa in the Gold Coast had not prevented a continuous increase in the shipments of cocoa, but the possibility of a reduction would be considered.—(July 17, 18.)

Smoke Abatement Bill

Sir A. Mond informed Mr. Betterton that he hoped to introduce the Smoke Abatement Bill at an early date.—(July 18.)

Cocaine

In reply to Mr. Lyle, Mr. Shortt said that no cocaine was produced in this country and that no statistics of consumption or trade were kept.—(July 18.)

Measuring Instruments Bill

A Bill to extend the powers of the Board of Trade, to make regulations with respect to measuring instruments used for trade, and to amend the law with respect to instruments used in ascertaining wages, and for purposes connected therewith, was presented by Sir W. Mitchell-Thomson and read a first time on July 19.

Safeguarding of Industries Act

Refund of Duty.—A motion, moved by Mr. Kiley, to insert a new clause in the Finance Bill providing for the repayment of duty collected on scheduled articles that have afterwards been removed from the lists, was rejected by 203 to 95 votes. Sir R. Horne observed that the Act specifically excluded the possibility of claims for refund of duty, and in any case it would be impossible to discover the person who in the end had paid the duty, as the article was usually sold before the inquiry was held.—(July 12.)

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Dumping.—Since Part II came into force in August, 1921, less than 120 trades or branches of trades have communicated with the Board of Trade. Of 45 complaints relating to goods made in Germany, 13 were referred to committees; in 29 cases complainants failed to establish a *prima facie* case or withdrew the complaints, or have been asked to supply further information; and 3 complaints are now being considered.—(July 10.)

Glass Bottles.—The Board of Trade is aware that, at the inquiry under Part II, a witness stated he supplied from his own factory 75 per cent. of the glass bottles used by the perfumery manufacturers in this country, and that the perfumery manufacturers deny this. No action need be taken as the Committee can call for further evidence if this is considered necessary.—(July 10.)

Questions in Parliament.—Approximately 300 questions relating to the Act have been addressed to the Board of Trade, and in addition a large number to the Treasury. No reliable estimate of the cost of these answers can be given.—(July 11.)

Procedure.—It is intended, when the reports of the Committees now sitting have been received, to review the position with a view to seeing what alterations, if any, can usefully be made in the procedure under the Act.—(July 17.)

Opal Glass Shades have been made in large quantities in the Birmingham and Stourbridge districts, but several factories have shut down owing

to trade depression and the output is now small.—(July 17.)

Complaints.—Since October 1, 1921, no complaints under Part II of the Act have been received that goods are being dumped from Germany.—(July 17.)

Synthetic Perfumes.—The Board of Trade is aware that toilet soap containing synthetic perfumes and dyes is being imported duty free into England, whereas when imported separately these perfumes and dyes are either prohibited or duty is demanded on them. It is not intended to introduce legislation to admit these chemicals free of duty.—(July 17.)

Glassware.—The case for making an Order (under Pt. II) relating to German-made glassware has been established. The question of Czechoslovakian glassware will be considered during the debate on the Act which must take place before the summer recess.

On June 5, 5010 glass-bottle makers, including 1336 labourers, were registered in Great Britain as unemployed, as compared with 4357 (including 1345 labourers) on December 2, 1921. Separate figures for machine workers are not available.—(July 17.)

Reports.—The reports of the Committees on scientific and optical instruments, glass bottles, and gas mantles, have not yet been received.—(July 17.)

REPORTS

FIFTY-EIGHTH ANNUAL REPORTS ON ALKALI, ETC. WORKS. 1921. By the CHIEF INSPECTORS. Pp. 32. London: H.M. Stationery Office, 1922. Price 1s.

Plants have been working under quite abnormal conditions during the year, and the work of the Inspectors has been unusually difficult. The number of complaints received regarding nuisances has not been large, and fifty per cent. of those received related to the refining of petroleum and tar-oil, the manufacture of fish manure and organic acids, and other works over which the Alkali Inspectors have no jurisdiction.

The total number of registered works in England, Wales and Ireland during 1921 was 1342, a decrease of 41 during the year. The number of separate processes of manufacture under inspection was 2150, a decrease of 91. The tabulated results of determinations of acid gases escaping show that reductions have been effected during the year in all classes of works.

Alkali Works.—In all districts the percentage condensation of muriatic acid gas was good. Alterations of plant at one works have resulted in a reduction of 50 per cent. of the acid escape. One of the complaints received was due to a temporary insufficiency of draught.

Cement Works.—Rotary kilns have now attained a length of over 210 ft., and have not, apparently, reached their final stage of development. Although black smoke is seldom seen, attention is directed to the necessity for careful control of combustion, as in one case hydrogen sulphide was emitted owing to a deficiency in the air-supply. In connexion with the recovery of potash salts, further investigation is needed upon details in each particular installation, and especially as regards the choice of filtering material.

Sulphuric Acid Works.—The demand for sulphuric acid has been comparatively small and has resulted in an accumulation of stocks of spent oxide. At a number of works where pyrites has hitherto been used, plant suitable for the burning of spent oxide has been installed. American sulphur, either alone or mixed with spent oxide, is also being used, thus eliminating the difficulty of dealing with the cupreous-pyrites residues and obtaining directly a practically non-arsenical acid. The best possible means of dust deposition should be adopted when burning oxide, particularly when mechanical furnaces are employed. Filtration presents difficulties and the passage of the gases through a large unpacked chamber, although most efficient, involves loss of heat. The provision of baffles in flues often results in little deposition of dust owing to the locally increased velocity. More attention should be paid to the use of sumps in flues, the introduction of secondary air after the burners, and the electrical deposition of dust. The provision of oxides of nitrogen for the chambers by means of the ammonia-oxidation process is extending. A further substitution of fans for steam jets for the purpose of draughting chamber sets is recorded. Attention is directed to the need of maintaining the efficiency of scrubbers attached to concentration plants.

Chemical Manure Works.—The average acidity of the gases escaping from scrubbing towers was equivalent to 0.06 grain SO₂ per cu. ft., as compared with 0.2 grain in 1903. Condensing flues play an important part in removing noxious compounds, and should be particularly considered where newer types of mixing plants are installed. An efficient scrubbing plant mentioned consists of a number of unpacked tower-chambers, each fitted with high-pressure water sprays, followed by two closely-packed water scrubbers, the latter being of considerable importance.

Sulphate and Muriate of Ammonia Works.—Owing to the coal strike, the high price of sulphuric acid and the low value of sulphur in spent oxide, these manufactures have been carried on under adverse conditions. The total quantity of ammonia products (expressed in terms of sulphate containing 25.75% NH₃) manufactured in the United Kingdom amounted to 253,253 tons, as compared with 397,937 tons in 1920. Activity is being displayed in the production of sulphate in a dry and neutral condition and in the recovery of muriate at coke-oven works. The heap system of purifying the foul gases from sulphate plants is found to be more satisfactory than the use of box-purifiers.

The increasing difficulties in disposing of spent liquors from the distillation of ammoniacal liquor have been specially investigated. The liquor is usually passed through settling pits in order to remove suspended matter, but phenoloid and other offensive vapours are evolved with the steam rising from the hot liquor, and local authorities often object to deal with the remaining effluent. The total volume of spent liquor to be handled in gas-works' practice is about 4000 galls. per ton of sulphate, and larger volumes are involved in coke-oven practice. In an appendix to the Report, methods of analysis are described, and it is shown that an average sample of effluent from the settling pits of a gas-works' sulphate-plant contains phenols equivalent to 0.8–1.5 g. C₆H₅.OH per litre, in

addition to thiocyanate and thiosulphate (*cf.* J., Skirrow, 1903, 58, Fowler and others, 1911, 174, Frankland and Silvester, 1907, 231). Devil liquors also contain hydrogen sulphide and hydrocyanic acid, and, as they are much richer in phenols, the practicability of submitting them to special treatment should be considered. The spent liquor from the stills has a high oxygen-absorptive power and develops a brown coloration which can be discharged by the addition of acid. It was found that by bringing the liquor into contact with waste combustion gases at a temperature near the boiling-point, a large proportion of the phenols together with any residual ammonia and pyridine could be volatilised. Further, the alkalinity of the liquor can be neutralised by the acid in the waste gases. A large-scale experimental plant has been erected, and further trials are being made; it is anticipated that by this means a deodorised and almost colourless effluent suitable for admission to the sewers will be obtained.

Tinplate Flux Works.—The preliminary cold-water treatment of scruff is being more widely adopted and analyses of chimney gases show considerably improved results.

Tar Works.—Abnormal conditions in the manufacture of coal gas have affected the character of the tar at some works, and in one case increased amounts of foul gases were produced. At several works the escape pipes from pitch coolers were inefficiently sealed. The tar distilled in the United Kingdom during 1921 amounted to 1,013,245 tons and the pitch to 384,416 tons.

Report on Scottish Works.—During 1921 there were 167 registered works in Scotland which operated 319 scheduled processes. In no case did the results of the chemical tests exceed the statutory limits. The depressed state of trade in comparison with the previous year (*cf.* J., 1921, 279 n) is shown by the following data:—Pyrites and spent oxide burned 71,416 tons, phosphates and bones dissolved 51,796 tons, salts of ammonia made (expressed as sulphate) 62,343 tons, tar distilled 148,608 tons, pitch produced 58,833 tons.

The condensation of noxious gases in chemical manure works has been improved as a result of the provision of additional condensing flues and careful control of the exhaust-fan. A market is required for the snowlike deposit of hydrated silica obtained. In the newer types of dens the acid steam evolved from freshly-made superphosphate is a cause of irritation. An improved quality of ammonium sulphate is being made, and the larger size of individual crystals now demanded is being obtained with vacuum saturators. For the dehydration of tar for road-making, additional stills of the continuous pattern have been erected.

THIRD ANNUAL REPORT OF THE GOVERNORS OF THE IMPERIAL MINERAL RESOURCES BUREAU. Pp. 72. Published by the Bureau, 2, Queen Anne's Gate Buildings, London, S.W. 1. 1922.

This report, covering the calendar year 1921, relates to changes in personnel, the collection and dissemination of information, the staff, the forthcoming British Empire Exhibition, the unification of mineral statistics, and financial matters. The greater part of the pamphlet is occupied by appendices, one of which, filling 36 pages, presents

a very valuable review of the principal mineral industries of the British Empire and foreign countries for the year 1921; another explains the efforts the Bureau is making to unify methods of returning and recording mining and metallurgical statistics. In the latter connexion it is worthy of note that, with but very few exceptions, the Bureau has adopted the British statute ton of 2240 lb. as the standard of weight and the £ sterling as the standard of value. The ambiguity of the terms "production" and "consumption" is discussed, and generally this part of the Report will prove very useful to those who have to deal with statistical information.

During the past year the Bureau has issued a large number of publications, many of which have been in great request. The series on the mineral industry during the period 1913-1919 is now nearly complete. A statistical summary of production, imports and exports of minerals from 1913 to 1920 was also published. The valuable work on the iron resources of the world is nearing completion (Pts. I to V have just been issued). Volumes on the mining laws of the Transvaal and British Columbia will be published shortly. A special compilation on the laws and regulations governing the employment of persons in lead mines and lead manufactories in all parts of the world, and a model code of mining ordinance for Kenya Colony, were issued during 1921.

In the interest of economy the paid staff of the Bureau has been reduced from 46 to 36, and other arrangements have been made to effect a total saving of £4000 per annum. Grants amounted to £16,800, of which £10,000 was contributed by the Imperial Government.

REPORT ON THE ECONOMIC SITUATION OF BELGIUM AT THE END OF 1921, REVISED TO MARCH, 1922. By R. F. H. DUKE, *H.M. Commercial Secretary, Brussels. Department of Overseas Trade.* Pp. 134. London: H.M. Stationery Office, 1922. Price 3s. 6d.

Before the war Belgium possessed many flourishing industries—chiefly coal-mining, metallurgy, textiles, glass-making, industrial chemicals, cement, bricks—and a comparatively small national debt. The war destroyed all these industries except coal-mining, deprived Belgium of her export trade and the assistance of German capital, and increased the national debt enormously. Economic recovery has, however, been wonderfully rapid, and the formation of combines, particularly in the metal, glass, textile, cement and building-material industries, has enabled the manufacturers to develop the export trade and to resist the economic stagnation more successfully.

By the end of 1920, 27 out of the 54 blast furnaces which existed before the war had been re-lighted, and the output of iron and steel was over one-half that of 1913. During 1921, however, owing to the steady fall in prices of metallurgical products and severe foreign competition, production declined, and manufacturers restricted themselves to working up imported raw steel. At the end of the year only 14 blast furnaces were in operation, but subsequently the receipt of foreign orders improved the outlook. The zinc industry, which suffered little during the war, was short of raw material, and owing to the high cost of coal

and labour, production declined from 84,252 tons in 1920 (41 per cent. of the output in 1913) to 66,470 t. in 1921. Reconstruction has not been so rapid in the lead industry, which is of lesser importance (*cf. J., 1922, 266 R*). The commercial agreement with Luxembourg (*cf. J., 1922, 202 R*) has been opposed on the ground that pig iron can be produced more cheaply in that country than in Belgium, which has to import the ore, and it has been proposed to form a Franco-Belgian-Luxembourg cartel to control the output of Alsace-Lorraine, Belgium and Luxembourg.

An approach to the pre-war level of prosperity was made in 1920 by all branches of the glass industry except that of table-glass, but in 1921 conditions were less favourable, labour and export difficulties proving serious, and attention was turned to the establishment of a special export sales-organisation. The chief producers are to participate in erecting a large glass factory to utilise the Foucault process in the Kaiping coal-mining district of China. Like other textile industries, the artificial-silk industry has suffered during the past year, but demand is now said to be in excess of supply; the export in 1921 was 153 t. and the daily output is now about 12 to 13 tons. The cement industry has been prosperous and the export trade considerable; the product has been improved by adopting the British standard specification, but picking is still faulty.

In the chemical industry the situation is not good, consumers are holding stocks, and the wage question and German competition are causing difficulties. The output of superphosphate fertiliser is still below the pre-war level of 230,000 t., but that of ultramarine has increased, so that sales of the British article have declined. The Fours à Coke Semet-Solvay and Piette (capital, 40 million francs), which is the chief manufacturer of coal-tar products in Belgium, has been working on only a small scale since the armistice. Many of the Belgian companies formerly under German influence have been acquired by the Compagnie Belge pour les Industries Chimiques (capital 50 mill. fr.), which is closely connected with French interests.

Among minor industries the match industry has been most successful since the war, both in the home and export trade. The paper industry, centred in the Ardennes and in Brabant, reduced production during 1920 on account of German competition. In 1920 the output of coal was 22.5 million t., compared with 18.5 mill. t. in 1919 and 22.8 mill. t. in 1913; production, however, is insufficient to meet the demand and importation is necessary. Developments are in progress in the coal-mining industry to improve materials, methods, etc.

Exports from Belgium in 1920 amounted to 10,518,593 t., valued at 8,708,082,000 fr., and 17,160,355 t., valued at 7,147,327,000 fr. in 1921, 15.5 and 17.6 per cent. by value being directed to the United Kingdom in the two years, respectively. The chief exports to the United Kingdom in 1921 were as follows (in 1000 fr.):—Copper, raw, 8497; iron and steel 61,301; lead, crude, 7121; lead 3107; zinc, crude, 15,030; zinc 9915; cement 15,010; basic slag 6055; superphosphate 11,994; chemicals 8478; vegetable oils (not olive or groundnut oils) 17,005; dyes and colours 7074; pottery 2056; glass 49,296; iron and steel 149,619. In 1920 the imports were 11,946,418 t. (11,171,467,000 fr.) and in 1921

17,511,863 t. (10,054,583,000 fr.), the percentage supplied by the United Kingdom being 17·2 and 11·17, by value, in these two years. Values (in 1000 fr.) of some of the principal imports from the United Kingdom in 1921 were:—Salt 1481; olive oil, groundnut oil 1707; edible fats 1903; non-edible fats 6670; vegetable oils 11,946; hides 28,744; ores 6857; copper, raw, 4454; copper 2800; tin, raw, 5069; coal 39,958; iron and steel, raw, 17,350; iron and steel 21,902; tar, tar oils, mineral oils 27,097; soap 1050; chemicals 17,249; dyes and colours 6811; paper 2644; pottery 3375. The fluctuating value of the franc has adversely affected British trade with Belgium. British goods still retain a reputation for superior quality, but if prices are not considerably reduced, better terms of credit given and more punctual deliveries made, trade will diminish.

The natural resources, trade and industry of the Belgian Congo are discussed and the opportunities for British enterprise outlined.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for July 13 and 20)

TARIFF CUSTOMS EXCISE

Australia.—The operation of the duties on citric acid, chamois leather, metal cordage (not including aluminium cable) has been postponed until September 30. Negotiations are in progress with Canada and New Zealand for reciprocal tariff arrangements.

Belgium.—Export licences are now required only for sugar, syrups of all kinds other than pharmaceutical syrups, and molasses.

Chile.—It is proposed to apply an export duty on ores of copper and iron.

Egypt.—A list of import valuations for iron and steel goods is given in the issue for July 20.

France.—By a recent customs decision nickel pellets are admitted duty free.

French Colonies.—The export or re-export of opium, morphine, cocaine and their salts is prohibited. Opium and opium products directed to Franco or in transit through French Somaliland are not affected.

Germany.—Artificial honey, cocoa butter, cocoa products, and other food products no longer require an import licence. In future the surtax leviable when customs duties are paid in paper currency will be fixed weekly on the basis of the dollar exchange for the previous week.

Lithuania.—Export licences are now required for, *inter alia*, cast iron, brass, silver, gold, fuel, bones, hemp, explosives, and malt.

Mexico.—The export duty on beans has been reduced to 1 cent per kg. The internal taxes on petroleum and its derivatives have been modified.

Newfoundland.—A Commission has been appointed to revise the customs tariff.

Poland.—An export duty of 15 Polish marks per kg. has been imposed on crude mineral oil.

South Africa.—Special duties have been adopted to prevent dumping from countries with de-

preciated currencies. The Board of Trade and Industries recommends that certain materials used for manufacturing goods within the Union be admitted duty free. The duty on starch has been fixed at 1d. per lb. A Bill has been introduced to prohibit, regulate or restrict the importation of boots and shoes, and sugar.

Spain.—A customs duty of 85 pesetas per 100 kg. on sugar, glucose, liquid caramel and similar products and consumption duties of 45 pesetas per 100 kg. on sugar made in Spain and 22·50 pesetas per 100 kg. on glucose have now been enacted. The import duty may be reduced temporarily by 15 pesetas per 100 kg. if Spanish manufacturers raise their prices unduly. A schedule of modifications in the customs tariff is given in the issue for July 20.

Switzerland.—The temporary reduction of the export duty on scrap iron to 40 centimes per 100 kg. has been extended until further notice.

Tanganyika.—The export duty on hides and skins is suspended until December 31.

United States.—A copy of the Narcotic Drugs Import and Export Act may be consulted at the Department of Overseas Trade.

Yugoslavia.—A new scale of monopoly duties has been fixed for explosives.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Argentina	Glass, glassware	225/6/F.G./M.C./A.
Australia	Heavy chemicals, fish oils ..	18
"	Explosives	412/20/7/3101*
"	China, pottery, glassware ..	412/20/7/3115*
"	Iron and steel, chemicals ..	412/20/7/3108*
Brazil	Paper	81
"	Chemicals, drugs, cement, crockery	82
Colombia	China, earthenware, stoneware	6260/F.L./M.C.
Costa Rica	Chemicals, drugs	83
Ecuador	Paints, oils, cement, earthenware	84
Egypt	Sheet zinc, zinc oxide ..	8610/F.E./E.C.
France	Tinplate	64
Holland	Heavy chemicals, pharmaceutical products, castor oil ..	35
"	Ammonium sulphate, superphosphate, etc. ..	36
"	Earthenware and fireclay goods	68
New Zealand ..	Paper	25
"	Leather	62
Norway	Artificial leather	69
Portugal	Rubber, lubricating and fuel oils	71
Sweden	Hides, leather and tanning materials	41
Switzerland ..	Olive oil, groundnut oil, sugar ..	43
United States ..	Linseed oil, coke	78
Uruguay	Pottery, glass, glassware ..	225/54/F.G./M.C.

* Official Secretary, Australia House, Strand, W.C.2.

TRADE NOTES

BRITISH

Seychelles in 1920

Considerable progress was made during 1920 in the distillation of essential oils, the exports being valued at Rs. 420,104. Towards the end of the year the European demand for cinnamon-leaf oil practically ceased, the price fell from Rs. 12 to Rs. 4 per kg., and many distilleries had to close down. Only three tons of vanilla was exported, and the crop was the smallest on record. The vanilla vines suffer severely from a disease, which is now the object of investigation. The crop of coconuts reached the estimated total of 23,159,172 nuts, of which nearly 18 million was converted into copra; the increased crop, compared with 1919, was due to the enforced cleaning of the plantations. The manufacture of soap, for which much coconut oil is used, was discontinued owing to the difficulty of importing soda. Exports of rubber declined from 13.4 t. to 10.7 t.; progress was made in extending the coffee crop and in reforestation; and the guano industry was restarted. Exports from the colony decreased in value by Rs. 389,422 to Rs. 1,711,955, owing to trade in copra re-attaining a normal level. Imports, valued at Rs. 1,716,408, increased, and a larger proportion than usual was derived from the United Kingdom.

FOREIGN

The New Bakelite Corporation

Following the legal action which resulted in the upholding of the Bakelite patents for the manufacture of phenolic condensation products, the Redmanol Chemical Products Co. has decided to combine with the General Bakelite Co. in order to prevent loss of goodwill, plant and organisation. The Condensite Co., controlled by the Redmanol Co., is also entering the new combine, which has been taken over by the Bakelite Corporation. The three companies will continue separately to manufacture and market their products, which supplement one another; thus galalith and "hexa" are made only by Redmanol, chlorine substitution products only by Condensite, and transparent material by Bakelite and Redmanol.—(*Chem. and Met. Eng.*, June 31, 1922.)

German Chemical Trade during May

H.M. Commercial Secretary at Berlin reports a slight improvement in the inland trade in coal-tar dyes. Foreign sales were satisfactory, and business remained at the level of the previous month in the Austrian Succession States, Holland and North Europe, but declined in Czechoslovakia, Finland and Belgium. Business was hampered in Northern Europe by offers of dyestuffs illegally exported from Germany, and by keen competition from many countries. The demand for pharmaceutical products increased, but that for chemicals continued to decline without, however, restricting full employment in the factories. Exportation was affected by fluctuations in the value of the mark and the world-market prices of certain chemicals were often reached and even exceeded. Supplies of raw materials improved, but soda had to be imported in bulk from France and Switzerland. Large orders for tinplate were placed in England and difficulties were experienced in obtaining supplies of packing paper, carbons, carbons, iron bars, etc.

Caustic Soda in Brazil

Owing to difficulties in obtaining supplies of caustic soda during the war, the Brazilian Government offered loans and concessions to encourage the manufacture in the country. This action resulted in the formation of the Cia. Brasileira de Productos Chimicos, which has erected a plant near Rio de Janeiro with a capacity of 5 metric tons of caustic soda solution (76°) and 10 t. of calcium chloride solution (35°) per 24 hrs. Since these products have been marketed imports of caustic soda have declined from 12,036 t., valued at 8,523,000 milreis, in 1920 to only 2899 t., valued at 2,567,000 milreis, in 1921 (milreis = 2s. 3d. at par, now 7.4d.). Although this heavy decrease was undoubtedly due largely to trade depression, the Brazilian demand for foreign caustic soda will probably be much restricted in future.—(*U.S. Com. Rep.*, May 22, 1922.)

REVIEWS

BASIC SLAGS AND ROCK PHOSPHATES. By GEORGE SCOTT ROBERTSON, with a preface by Sir EDWARD J. RUSSELL. *Cambridge Agricultural Monographs.* Pp. xiv+120. Cambridge: The University Press, 1922. Price 14s. net.

Much interest is being taken at the present time in the production of basic slags and in their value as fertilisers, and at the same time the not less important question of the manurial value of ground rock phosphates, and of the extent to which they can replace basic slags as fertilisers, is receiving much consideration. The monograph by Dr. Scott Robertson on basic slags and rock phosphates, which has been issued as one of the Cambridge Agricultural Monographs, appears therefore at a particularly appropriate time, and should be very useful to all agricultural teachers and agricultural chemists.

For a long time basic slag was not very popular with the British farmer. Whereas Germany, the largest producer, consumed at home nearly the whole of her millions of tons, it was not sufficiently appreciated in this country, in spite of the evidence obtained at Cockle Park and elsewhere, to prevent a considerable proportion of our relatively small production being exported. Under the stress of war necessities the British farmer at last learnt to appreciate basic slag, and during the years 1917 and 1918, though the home production was greater than ever before, it was all used at home. It was through experiments made with slag produced by the basic Bessemer process that the reputation of basic slag as a manure was established, and it seems almost tragic that when British farmers had at last learned to appreciate and use this fertiliser, changes in the steel industry have made it necessary again to undertake the whole process of determining by field experiments the value of basic slag relatively to other phosphatic manures. Most of the basic slag now on the market is not the same substance as the old Bessemer slag, from which it differs both in the percentage and in the solubility of its phosphate.

Closely related to the slag question is that of the fertilising value of ground rock phosphates, and this also has recently assumed new importance. The orthodox agricultural chemistry of the past taught that rock phosphates are of little or no value as manure until they are dissolved to form super-

phosphate. There have always been a few unorthodox persons who have maintained that ground rock phosphates have in themselves a high value, and during the past twenty years opinion has gradually been coming over to their side, as evidence has accumulated showing that, weight for weight of phosphate, nearly as good a result can in many cases be obtained from ground rock phosphate as from superphosphate, and that therefore, to a large extent at any rate, it is unnecessary and wasteful to use superphosphate.

Dr. Scott Robertson's little book is mainly taken up with a record of field experiments carried out on grassland in Essex with basic slags of different kinds, and with ground rock phosphates from North Africa, Florida and elsewhere. Sir E. J. Russell, the director of the Rothamsted Experiment Station, who is chairman of a Departmental Committee appointed to consider the question of the supply of basic slag, provides an introduction.

The opening historical statement and the review of previous experiments are short and might usefully be enlarged in a new edition. These sections are so incomplete that they hardly give a fair and balanced impression of the development of the use of slag and rock phosphates.

The really valuable part of the work is the account of Dr. Robertson's own experiments on grassland in Essex, which occupies by far the greater part of the book. These experiments were carried out on eight different farms on soils of three different types and are characterised by certain distinctive features. The improvement obtained is not measured merely by weighing the crops of hay, but careful hotanical analyses were made, and the effect of the manure in changing and improving the kind of plants in the pasture is carefully discussed. The relation of the phosphatic dressings to the accumulation of nitrogen in the soil, and their effect on the soil bacteria, and on the soil acidity, moisture and temperature, are all critically examined in a scientific manner, and conclusions of much interest are drawn. The results in general show that rock phosphates "give results approximately equivalent to those secured from the high citric-soluble types of basic slag" and that whilst the low-soluble fluor-spar basic slags have effected considerable improvement they "have undoubtedly proved to be less effective than either the high-soluble slags or the rock phosphates."

Dr. Robertson states his conclusions moderately, and the economic importance of the questions involved is so great that he might perhaps have been a little more emphatic in stating the conclusions at which he has arrived, even though they may sound unorthodox to those who hold that agriculture cannot prosper without basic slag.

The book has a good index and is illustrated with reproductions of a number of excellent photographs.

JAMES HENDRICK.

L'AZOTE. By L. HACKSPILL. Pp. xii+271. Paris: Masson and Cie. and Gauthier Villard et Cie., 1922. Price 14 francs net.

This volume, which is one of a series of monographs included in the *Encyclopédie Léauté*, contains a well-written review of the principal processes of nitrogen fixation by an author who has had considerable opportunity for studying these in

actual operation. The fourteen chapters contained in the book include a description of the technical manufacture of the more important nitrides and of calcium cyanamide, of the synthesis of ammonia, and of the fixation of nitrogen by the arc process. In addition, various operations subsidiary to the main process of fixation, such as the preparation of nitrogen and of hydrogen, the absorption and concentration of oxides of nitrogen and of nitric acid, and the formation of various ammonium salts are described; further, constructional details and the number of plants of various types known to be in operation are frequently given. In particular, the account of the Oppau and Merseburg synthetic-ammonia plants, including the methods employed in carrying out many of the subsidiary operations involved, is worthy of note. A special chapter is devoted to the use of abnormally high pressures by Claude, and further sections contain a general economic review of nitrogen fixation, of the utilisation of artificial nitrogenous manures, and of the production and consumption of nitrogen compounds in various countries.

On the whole, Prof. Hackspill is to be congratulated on the production of a very readable and well-arranged work, which appears to be exceptionally free from misstatements and from serious misprints. The statement on page 15 that nitrogen, on being activated by electric discharge at low pressures "devient lumineux pendant un certain temps, plus long si l'on refroidit, plus court si l'on chauffe" cannot, however, be accepted as completely accurate in view of Strutt's observation that an afterglow, which persisted at room temperature for slightly more than a minute, became extinguished in fifteen seconds at the temperature of liquid air. Similarly, misprints occur occasionally in the spelling of proper names. Thus, "Briegler" for "Brieglieb" (p. 17), "Scheffield" for "Sheffield" (p. 73), "Clause" for "Claude" (p. 84), and "Vant 'Hoff" for "Van't Hoff" (p. 156), in addition to other minor misprints, were noticed on reading through the volume, but small inaccuracies of this type do not detract from the general utility of the work, which forms a very acceptable addition to the literature of fixed nitrogen. The diagrams are excellent, particularly since many of them are marked with the actual dimensions of the plant illustrated, thus allowing a far more accurate conception of relative sizes to be obtained than is possible from purely diagrammatic sketches.

E. B. MAXTED.

PRINCIPLES OF LEATHER MANUFACTURE. By H. R. PROCTER. Second edition. Pp. viii+688. London: E. and F. Spon, Ltd., 1922. Price 33s. net.

In 1903 Prof. Procter's "Principles of Leather Manufacture" replaced his still earlier "Text-Book of Tanning," published in 1885. The great advances made since then in the science and practice of leather manufacture have necessitated another edition, and the above volume replaces the first edition as the standard work on the subject and the final authority on all matters within its scope. The second edition contains 170 more pages than its predecessor, and its printing, illustrations and binding are worthy of its high position in technological literature. The general scheme of division

into chapters adopted is the same as in the first edition, each chapter being expanded, several new ones added and an appendix inserted containing several original contributions by various authors.

Starting with a brief description of the living cell, the mechanism of putrefaction and fermentation under the influence of moulds, yeasts and bacteria is described. A chapter devoted to a full account of the antiseptics and disinfectants applicable to hides and skins is followed by a description of the origin and curing of the same, special reference being made to the cause and prevention of salt stains and the damage to hides caused by the warble fly. The chapter on the structure and growth of skin is illustrated by excellent photomicrographs by A. Seymour Jones and R. H. Marriott. The section dealing with physical chemistry as applied to the leather industry is greatly enlarged, special attention being given to the measurement and effects of variations of hydron concentration and a chapter devoted to colloid solutions and the colloid state. A chapter on the chemistry of hide nearly completes the scientific as distinct from the practical part of the book. Henceforward the processes of leather manufacture are dealt with in the order in which they are carried out in the tannery, separate chapters being devoted to softening of hides and skins, depilation, deliming, bateing, puering and drenching, and pickling and de-pickling.

Of actual tanning processes, those by means of chrome, alun and iron are first considered, the two former in considerable detail. A very complete account of the vegetable tanning materials follows, occupying nearly 60 pages and containing many illustrations, and the tannage of sole leather with these materials is described, combination tannages being briefly dealt with. Accounts of the grinding and extraction of tanning materials and evaporation follow. The chemistry and analysis of oils and fats occupy 30 pages, and chapters on their use in leather manufacture are included. Dyes and mordants as used on leather, evaporation, heating and drying, maintenance of tanneries and disposal of waste products are treated in detail in the last four chapters.

In the appendix, full extracts, with a number of tables and diagrams, from the papers by the author and Wilson on the gelatin equilibrium are given. M. C. Lamb contributes a list of dyes suitable for use on chrome and vegetable-tanned leather, and papers by Atkin and Thompson on the determination and control of acidity in tan-liquors, and by W. R. and J. Atkin on the caustic alkalinity of lime liquors, are included.

Many practical books consist of a monotonous catalogue of processes, good, bad, and indifferent, of the majority of which it is extremely unlikely that the author has any personal knowledge. On the other hand, scientific teaching requires to be presented to the average tanner in a very clear way if he is to listen to it. Prof. Procter, as a practical tanner, can give the manufacturer much valuable advice, and as an eminent scientist his gift of lucid explanation is such that his exposition of the science and theory of the industry can be profitably studied both by the non-practical man unacquainted with the industry and by the manufacturer desirous of understanding more of the principles underlying his processes.

DOUGLAS J. LAW.

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REVIEW

Vol. XLI]

AUGUST 15, 1922

[No. 15

THE TRAINING OF THE CHEMICAL ENGINEER*

R. F. RUTTAN

THE great field for the development of stable chemical industries in Canada is the utilisation of those natural resources which we possess in greater quantity, and more conveniently situated, than other countries. This need not call for original research but rather for adaptation to our conditions, of methods, principles and processes already known and well tried elsewhere. This is obviously the function of the chemical engineer, and it is from the young chemical engineer that we may expect the kind of industrial research which the country needs at present.

The scientific army of Great Britain has always consisted of a brilliant group of staff officers, but before the war England had not learned how to make the most of her mediocre ability. She did not recognise that without the scientific rank and file it would be impossible to staff the industrial research laboratories so as to compete with the more elaborate organisations of Germany and America. The English idea was that the two professions should be kept separate, each specially trained for its field of work, and that a chemical job should be done by a chemist and an engineering task by an engineer. The two, it was thought, should not be combined because the two subjects were too big for one man, save in a few exceptional cases. This is certainly true when the course of training does not exceed three years.

I think that most of the leaders in chemical industry in England are now willing to concede that the engineer should be taught sufficient chemistry to be able to appreciate the chemist's point of view, and that the chemist should know enough of engineering to realise that he can safely leave the practical application of the processes he devises in the laboratory to the engineer thus trained. The principle of "one man, one job," is thoroughly English, but it may be carried too far. One cannot overlook the important rôle played in the chemical industries of America and Germany by a class of scientific men who are neither highly-trained engineers nor highly-trained chemists, but who are recognised as a class, and many of whom

have a great deal more in them than a knowledge of chemistry and of engineering.

It has been pointed out that as the engineer and the chemist become more highly trained and specialised, their paths become more divergent, and their points of view irreconcilable; in short, the experience of many heads of works is that the two types are largely incompatible. A works chemist defined the average engineer as "an empyric who has been trained on cotton waste and engine-oil"; and a works chemist has been described by an engineer as "an organic body more liable than any other of similar nature to spontaneous explosions." Chemists and engineers have also been called the physicians and surgeons of industry. On this analogy the chemical engineer would represent the general practitioner of the chemical industries; like the physician, his chemical knowledge enables him to see below the surface, to diagnose from physical signs unseen changes and conditions, and from his experience to find a remedy for any abnormal reaction. Just as there is a limited number of unseen organs in the human body to be studied and observed, so in a chemical works there is a limited number of operations, more or less invisible, going on in chemical units, each with its clinical thermometer, pressure-indicator, etc. attached to give early symptoms of any departure from the normal. The engineer in charge, like the surgeon, has to deal with the adjustment, repair and alterations of the anatomical units, the works, the accessible outward portions. Just as minor surgery constitutes a large part of the activities of the general practitioner, so frequent minor adjustments, alterations, improvements and repairs skilfully carried out form the larger part of the duties of the chemical engineer. Like the general practitioner, the chemical engineer should know his limitations and, when necessary, consult the specialist, the electrical or hydraulic engineer, or the chemist.

No analogy, however, should be carried too far, but it is worthy of note that the best specialists in any field of medicine or surgery are those who have spent years as general practitioners. Therefore knowledge of the general practice of chemistry and engineering in works is a very sound basis on which to build expert knowledge in either branch of science.

* The substance of an address delivered at a joint meeting of the Chemical Engineering Group and the Chemical Industry Club in the Savoy Hotel, London, on June 28, 1922.

During the past few years there has been a very prolific discussion regarding the best course of training for the chemical engineer. It has become generally recognised, on both sides of the Atlantic, that progress in industrial chemistry is based upon both engineering and chemistry, and that the Universities have failed to impart just the right type of education. This is due to the fact that the Universities are unable to teach the control of chemical reactions and the handling of materials on a sufficiently large scale. The best that can possibly be expected of the University in a course of four years is to give a broad and scientific foundation. After having once entered upon the work of his profession it is only in very exceptional cases that a man returns to the University for further training in research. Admitting the unsatisfactory and incomplete training which is now being given, the time seems ripe to consider some plan which will provide better-trained chemical engineers. The plan which, in my opinion, gives promise of meeting these requirements, is an adaptation of one which has been developed, and is now being tried, by the Massachusetts Institute of Technology, Boston. This unique scheme of education, which was evolved by a committee of engineers (of which Mr. A. D. Little was chairman) appointed by the Institute, has up to the present time completely realised the expectations of those who introduced it.

We recognise that chemical processes, whether on the laboratory or the factory scale, consist of a series of collected "unit" actions, such as pulverising, mixing, heating, roasting, absorbing, precipitating, condensing, crystallising, filtering, and electrolysis. The number of these basic unit operations is not very large, and only a few of them are to be seen in any particular works. To afford an insight into the real problems requiring industrial chemical research, the Institute mentioned established five or six chemical engineering and research stations in direct contact with important industries. These were selected with a view to bringing to the attention of the engineering student the largest possible number of the unit operations of which chemical processes are generally composed. The stations have a threefold function: (a) practical instruction in chemical engineering; (b) instruction of ambitious foremen and others in the works in the fundamental principles governing their operations; and (c) advancement of industrial research in special industries. The equipment of each station consists of a small building of one storey which contains a small reference library and a very complete collection of photographs and drawings of apparatus and machinery utilised in the local industry, but not installed in the locality; a conference and lecture-room to accommodate fifteen or twenty people; a small laboratory with benches for the same number; an office for the station director; and

a laboratory for specialised industrial research, with space and equipment for five graduate research assistants. The cost of such an equipment would be from 10 to 20 thousand dollars in different industries.

According to the arrangements at the Institute the students leave the University about the middle of their fourth year, and spend the period from January to September in moving from station to station, spending about six weeks at each. An instructor is in charge of each station, and maintains the same strict discipline among the students as is found at the University. Each day's work is carefully planned, and daily lectures on different stages of the process form a part of the system.

The five-year course is designed to fulfil the following objects:—(1) To acquire a first-hand knowledge of the processes, plant and machines in the equipment. (2) To study the chemical control of industrial processes through the laboratory, and to acquire ability in the interpretation of laboratory data in terms of factory practice. (3) To obtain a general knowledge of modern methods of factory management and control, together with methods of apportioning cost of manufacture. (4) To obtain the wider viewpoint which comes from contact with those who are employed to superintend or carry out factory operations, and to acquire the degree of confidence in handling industrial processes and large-sized apparatus which comes from actual participation in the work of the plant. (5) To acquire that inspiration for further work in science and research which intimate contact with large progressive industries inevitably affords. On returning to the Institute to complete his fifth year, the student follows a course of advanced lectures and laboratory work, the value of which he will appreciate as the result of his experience in the works. The above description is the substance of the report of the committee presided over by Mr. A. D. Little.

This, in outline, is the object and method of this new plan of educating chemical engineers. It is our purpose to adopt a modified form of it in Canada, and this will require co-operation among the engineering faculties in Canadian Universities on the one hand, and a successful appeal to the captains of Canadian industry on the other. The Universities must agree upon the necessity for a five-year course in chemical engineering, and be convinced that one year spent chiefly in works' training is the best way of employing the students' time. Success or failure will depend very largely upon the manufacturers; without their cordial co-operation and assistance the plan is obviously doomed to failure. In the United States every industry invited gladly accepted the opportunity of having a station in the works. The Honorary Advisory Council for Scientific and Industrial Research has appointed a committee to look into this question and to formulate a plan for

putting it into effect next year. It seems to me a very obvious and effective method of bringing into closer relation the Universities and the industries of Canada, enabling the former to ascertain the important industrial problems of the country, and giving the industries an opportunity of utilising in part the teaching and research powers of the Universities. Not only would this scheme give our students in chemical engineering a range of experience impossible to obtain otherwise, but the stations could offer special courses in the technology of their industry to superintendents, foremen, etc., thus forming a sort of university extension in chemical industry. The plan lends itself with peculiar effectiveness to the development of industrial research at each station. The director in charge of the station would obviously be a well-trained chemist or chemical engineer who has specialised, or intends to specialise, along the lines of the particular industry or industries with which he is connected.

The application of this scheme of training to Canadian conditions will not be easy. In the first place, the total number of graduates in chemical engineering and chemistry in Canada is less than is annually turned out by the Institute of Technology; hence the field from which we can select is smaller. The average student at the Institute is financially better able to spend the extra year, with its additional tuition fees and travelling expenses, than is our Canadian student. Again, few industries are on a scale comparable with many in the United States. But these difficulties are not insuperable. There is little doubt that industrial chemistry is offering such a future to our technically-trained graduates that chemical engineering is rapidly becoming the most attractive career for the engineering student, and the required number will soon be available. If the universities gave the Bachelor degree at the end of four years and a Master's degree in Science after five years; if the fees were made as low as possible and substantial Government assistance be given to these training centres, the obvious value of this practical training would soon create a competition among the students for the privilege of being admitted to the course.

The station in each centre would become the scientific bureau of information and research for the local industries, and would go far to introduce an atmosphere of science into those industries in which chemistry plays a part.

Finally, I feel strongly that the chemical engineer so trained is just the type of man to develop our industries. He would be a University man familiar with the engineering problems presented by chemical industries, one whose capacity for initiative and for attacking scientifically an industrial problem would be many times that of the present science graduate, however good his university training may have been.

CONSTRUCTIVE INDUSTRIAL HYGIENE IN THE INDIARUBBER INDUSTRY

C. A. KLEIN

EARLY in 1921 the Home Secretary, under Section 79 of the Factory Act of 1901, certified as dangerous the following processes incidental to the manufacture of indiarubber and indiarubber goods:—

(a) Vulcanising by means of the cold cure process or by any other process involving the use of carbon bisulphide, sulphur chloride, carbon-chlorine compounds or benzol (pure or commercial);

(b) Any process involving the use of lead or compounds of lead.

This certification by the Home Secretary is a necessary preliminary under the Act when it is intended to institute regulations for the hygienic control of an industrial process.

Shortly after the certification of the above processes as dangerous, the Secretary of State issued draft regulations which it was proposed to institute in connexion with these processes and, as prescribed, the draft regulations were submitted to those concerned and interested in the matter. After mutual criticism and discussion, a final form was agreed and Statutory Rules and Orders, dated March 31, 1922, now known as the "Indiarubber Regulations, 1922," came into operation on May 1 of this year.

The regulations divide the above-named processes into two kinds, viz., "fume processes"—i.e., those referred to under (a) as above—and "lead processes," or those described under heading (b). The regulations for the two types of processes are almost entirely distinct, but few having dual reference.

In the regulations dealing with "fume processes," the essential feature is protection against the injurious effects of the vapours of volatile solvents used in indiarubber manufacture, the provisions being for minimum age of employment, limitation of hours worked, prohibition of the use of such processes in the open air, the application of exhaust draught or (when only benzene—pure or commercial benzol—is used) of efficient ventilation, the adoption of means to minimise the amount of vapour entering the air, messroom, medical examination at prescribed intervals, maintenance of health register, and rules for the re-employment of persons suspended by the certifying factory surgeon.

These new regulations supersede the Special Rules in operation since May 1, 1898, for "The vulcanising of indiarubber by means of bisulphide of carbon," and are more comprehensive and applicable to processes in which other volatile products are used.

The inclusion of liquids containing benzene and the carbon-chlorine compounds, indicates

the increased employment or introduction of such compounds in the rubber industry and implies that the toxicity of the vapours of these compounds has been definitely established by practical experience. The toxic properties of the vapours of such bodies have been known for some time and the new regulations will cause little surprise—in the opinion of some, they were long overdue.

There has recently been much discussion as to the toxic effects produced by the vapours of the volatile thinners used in painting operations, and, as certain of the volatile thinners are common to the paint and rubber industries, the recognition of these vapours as dangerous in the rubber industry has an important bearing on the question under discussion. It has been suggested that the conditions obtaining in the two trades are not comparable, but as yet no evidence has been brought forward in support of this contention. The question at issue, though complicated, as are all questions involving the resistance of the human body, must be studied in its broadest aspect, for in no line of inquiry is the old saying that "one man's meat is another's poison" better illustrated. Personal idiosyncrasy plays a large part in these matters and until the subject has been carefully studied, it would appear as if Rolands and Olivers can be produced in about equal numbers, and the true position will not be known until the many and varying factors involved have been carefully considered.

The regulations for "lead processes" closely follow in principle those which in recent years have become standard in this country for all processes involving exposure to lead compounds, and provide for a minimum age of worker, exclusion of any female under 18 years of age from any lead process, application of exhaust-draught for the removal of lead dust at (or as near as possible to) its point of origin, mess-rooms, regular supply of clean overalls, accommodation for clothing put off during working hours, washing facilities, medical examination, maintenance of health register, rules as to the re-employment of workers after suspension by the certifying surgeon, and finally, facilities for the sampling of materials by Government inspectors.

The final requirement, which refers to the sampling of materials used, follows the practice which has been in vogue for some years in connexion with the use of lead compounds in the manufacture of pottery, and has been recently incorporated in the Women and Young Persons (Employment in Lead Processes) Act, 1920. In the latter case, as in the Indiarubber Regulations, the provision is made in order to afford samples, from the examination of which the process is to be classified as a 'lead process' or otherwise.

The test employed is the Thorpe solubility test by which the solubility (expressed in terms of PbO) of the material in 0.25 per cent. hydro-

chloric acid, is determined: one gram of the material being shaken for one hour with one litre of acid at common temperature and afterwards allowed to stand for one hour before the solubility is determined. The basis for the classification of operations prior to that of incorporation, is the solubility of the dry material, and, as it has been found that the test cannot be applied to mixtures containing rubber, the incorporation processes are classified on the basis of the solubility of the mixed mass as calculated from the solubility of the dry material and the quantity of the same in the mixture. Materials having solubilities not exceeding 5% when determined by such methods, are regarded as innocuous and processes involving their manipulation are not "lead processes": consequently, the provisions of the Regulations do not apply thereto.

The Lead Regulations, although new to the indiarubber industry, have been in operation in other industries for many years, and embody the principles which experience has shown to be of fundamental importance.

It does not appear to be known, except by those who have immediate interest in the subject, that this country was the pioneer in the study and control of industrial lead poisoning and that the progress made is regarded as a unique demonstration of the successful application of the science of industrial hygiene—a science which, to-day, is making rapid strides in spite of its comparative infancy. In Great Britain there were over 1000 cases of industrial lead poisoning in the year 1900. To-day, the annual figure is about 200, and this remarkable improvement has been effected without any serious interference with the progress of industry.

During the last twenty years, lead and its compounds have been more largely used than hitherto, whilst, as has been shown, the incidence of poisoning has fallen sharply. This progress is due to sympathetic co-operation between the officials of the Home Office, the employees, and the manufacturers. In no single case has it been deemed necessary to prohibit the use of compounds of lead, despite the occasional outbursts of certain well-meaning but uninformed and ill-advised amateurs who have clamoured for prohibition as the only panacea, heedless of any consideration of the economic aspects. Nothing is more conducive to lasting progress in industrial hygiene than harmonious co-operation of employers, employees and Government Departments: fortunately, it is in this way that English industrial hygiene is proceeding.

It is not here suggested that the limit of improvement in respect to industrial lead poisoning has been reached, for there is clear evidence to show that further reductions are possible, and there is little doubt that these reductions will be made in due course. The whole of the accumulated evidence goes to show that the problem of industrial lead

poisoning is essentially one of dust, or to use the words of Dr. Legge* (H.M. Medical Inspector of Factories):—

“On the practical side little more is to be learned as to how lead poisoning is caused, and it can be taken as axiomatic that all risk lies in the inhalation of dust or fume. These removed or prevented, there would be no lead poisoning.”

Nothing could be more definite or helpful than such a conclusion and the direction in which efforts must be concentrated is clearly defined—a position which is in striking contrast with that obtaining some few years ago when, at frequent intervals, those handling lead compounds were seared by the publication of alleged discoveries and alarmist theories as to sources of poisoning which proved costly to investigate and were invariably found to exist only in the imagination of their authors.

The lead compounds used in the rubber industry are litharge, and to a smaller extent, white lead, red lead, and basic sulphate of lead. These products are used in the dry form in mixture with other powders and are incorporated in rubber on slowly-revolving, heated “mixing” rolls. The dry powders are distributed by hand over the rubber as it passes through the heated rolls, and the operation is continued until all the material has been added and is thoroughly incorporated.

The cases of lead poisoning arising in this industry occur among those engaged in weighing out dry lead compounds and, to a much greater extent, among workers employed at the incorporating rolls. In both cases the danger is clearly attributable to dust, aggravated in the operation of incorporation by the current of hot air which rises from the rolls, carrying with it a certain quantity of lead dust. As an example, Legge and Goadby† instance an indiarubber factory for which the records of poisoning are available before and after application of exhaust ventilation over the heated “mixing” rolls. Before the alteration was made, out of fourteen men employed thereon, ten showed a blue line, five were markedly anæmic, one had weakness of the wrist and two weakness of grasp. In a period of ten years after the application of exhaust ventilation, only one case had been reported.

The total quantity of lead compounds used in the indiarubber industry is very considerable, but the distribution of cases of poisoning bears no sensible relation to the weight distribution of the raw materials. In this industry, as in others, it is found that controlled workers may use large quantities of lead compounds without ill-effects, whilst in the hands of careless workers, or when used in unprotected apparatus, small quantities of lead compounds may give rise to a large number of poisoning cases.

There is a growing tendency in the lead industry to centralise the dangerous processes so that they can be operated by a small number of workers producing materials which are much less toxic than their separate constituents. It is obvious that this method is the only scientific and rational solution of the problem, and its application where possible should need no advocacy.

As an instance of what has already been successfully done, mention may be made of low-solubility lead silicate which is now used in large quantities in pottery work. This product, which contains approximately 65 per cent. lead oxide, combined with 35 per cent. silica, has a solubility of less than 5 per cent. when determined by the Thorpe solubility test, and can be used by the potter with comparative safety, being much less soluble than white lead, litharge, red lead or even the lead silicates formerly used. In this case, it has been possible to render the lead comparatively innocuous by chemical means, but there are industries in which this is not desirable and therefore alternative means have had to be found.

In certain industries, it was formerly the practice to purchase dry lead compounds for use in operations where they would be ultimately wetted by water, and, owing to the dust created in the handling of these dry compounds, an unnecessary amount of lead poisoning occurred: this has since been obviated by substituting water pastes for the dry compounds, thus overcoming the risk of poisoning through dust in the production of the lead material and its subsequent use.

The Indiarubber Regulation of 1922 have given an impetus to progress in another direction, and mixtures of pure rubber with various lead compounds have recently been put on to the market. The mixtures, which consist of 80 parts of lead compound incorporated with 20 parts of pure rubber, are sold in the form of thin sheets which are homogeneous in composition, and are used in the incorporating rolls in the place of dry lead compounds. In practice, it has been found that the mixture incorporates with the other ingredients quite satisfactorily on the rolls and a demand for the product has been established. The material is produced in lead factories where there are already in operation the most up-to-date methods of hygienic control under the supervision of those daily concerned with the handling of lead products in large quantities. It is obvious that no lead dust can be created by the indiarubber manufacturer in the handling of this mixture and that it is entirely free of danger. The Factory Department of the Home Office has given the matter serious consideration and has decided that the mixtures are neither “dry compounds of lead” nor “dry mixtures containing dry compounds of lead,” and therefore, that any process in which

* Annual Report. Chief Inspector of Factories, 1918. Cmd. 340, p. 66.

† Legge & Goadby. Lead Poisoning and Lead Absorption. Arnold: London, 1912, p. 301.

the mixtures are used, is not a "lead process" to which the Indiarubber Regulations, 1922, will apply.

By substituting this material for raw lead compounds, the rubber manufacturer will not only be free of control in respect to the use of lead compounds, but will at the same time, have the satisfaction of knowing that his work-people are handling a material which cannot, in any normal circumstances, exert an injurious influence on their health. There would appear to be no reason why the material should not be generally used in the indiarubber trade to the exclusion of raw lead compounds, but in particular, it seems to be eminently suitable for small manufacturers whose use of lead compounds is necessarily limited, and to whom the installation of apparatus and control demanded by the new regulations might be somewhat onerous. The future progress of the material will be watched with great interest because it is a fresh advance in modern industrial hygiene, the aim of which should be, not the destruction of industry, but its maintenance coincident with improvements in the hygienic conditions of employment.

THE THIRD INTERNATIONAL CHEMICAL CONFERENCE

THE Third International Conference of Pure and Applied Chemistry was held in Lyon from June 27 to July 1, Prof. C. Moureu (France) again presiding (*cf.* J., 1921, 267 n). The 100 to 120 representative chemists who attended were delegates from the twenty-four countries composing the Union. The delegates from the Federal Council of Pure and Applied Chemistry, the English section of the Union, were Sir W. J. Pope, Dr. T. H. Hewitt, Prof. T. M. Lowry, Dr. S. Miall and Dr. E. Mond. Canada was represented by Mr. A. T. Charron and the United States by Dr. C. L. Parsons, Prof. E. Barlow, R. B. Moore, and L. W. Washburn.

The Union discussed a large number of questions of interest to the chemical community as a whole and with the aid of its numerous committees came to a number of conclusions which will be submitted to the chemical organisations of the countries which compose the Union. A few of the conclusions thus arrived at are summarised below.

Nomenclature.—The question of introducing such unifications and conventions into the methods of naming and describing chemical substances as will facilitate the production of indexes in the chief languages which will be interchangeable as far as possible was discussed at length. On the motion of Sir W. Pope, it was decided that all questions of chemical nomenclature should be submitted for consideration to the editorial staffs of the chief chemical journals and that the work of the Committee should be restricted to the discussion and criticism of the reports received from the editorial staffs. A Committee consisting of Messrs. Greenaway, Marquis and Patterson was appointed

to prepare a complete system of nomenclature that could be used by all the journals devoted to chemical science and technology. It was decided to publish the report of the Committee on biochemical nomenclature.

Bibliographical Contractions.—It was recommended that the abbreviations of the titles of periodicals used by "Chemical Abstracts" should be adopted and that a title not printed in Roman type should not be translated but transcribed in the manner proposed by the periodical itself. In accordance with the wish of the National Research Council of Japan the proposal to abbreviate the word "Japanese" to "Jp" and not "Jap" was accepted. Further resolutions bore on the establishment of central bureaux of bibliographical documentation and the use of the decimal system of the International Institute of Bibliography for classifying papers on chemical subjects.

Physico-Chemical Standards.—The work done by this Committee related chiefly to the provision of a further scientific worker for the staff of the Bureau of Physico-Chemical Standards, hitherto supported entirely by contributions from Belgium.

Research Chemicals.—To avoid delay in obtaining practical results the Committee has restricted its work to accurate descriptions of the qualities required in common analytical reagents; the descriptions are to be published in an international codex. When this task has been accomplished attention will be paid to chemicals used for purposes other than analysis. In addition to a resolution aiming at facilitating the work of the national delegates on the Committee, it was proposed that, in the volumetric estimation of the halogens in seawater, pure sodium chloride should be used as a standard in preference to standard seawater.

Technical and Industrial Products.—This Committee pointed out the utility of lists of manufacturers of chemical products and suggested that the example set by Great Britain in this respect should be followed by the other adherent States. The lists should be kept in Paris at the central bureau, but to avoid excessive centralisation, a delegate in each country should be appointed to receive copies of all the catalogues and documents sent to the Bureau.

Thermochemical Standard.—Benzoic acid was recommended for use in standardising calorimeters, the heat of combustion of 1 g. weighed in air being fixed temporarily at 6321.15 cal., *i.e.*, 6319.15 cal. per g. *in vacuo*. The standard acid, prepared by the Bureau of Standards, Washington, can be obtained from the Institut International d'Etalons Physico-chimiques at Brussels. Authors who publish data on the heats of combustion are asked to quote the figure they have adopted for the heat of combustion of the benzoic acid used in standardising the calorimeter and, as far as possible, to give their results in absolute units.

The report of the Committee on tables of constants, proposing the establishment of an international fund for its work, was adopted and progress was made in discussing the possibility of devising an international patent scheme. It is anticipated that the Union will be able to issue its various tables of constants of the elements, dealing with isotopes, radioactivity and atomic weights, for 1923 at the end of the present year. Reports presented by the Committees on food preservation, fuels, ceramics and industrial hygiene were also approved.

During the past three years the Union has necessarily been occupied largely with settling the details of its organisation and with organising formal matters of international interest, such as the production of tables of constants of the elements. It is felt that the time has now come when the programme of the annual meeting may profitably include the discussion of scientific and technological problems of broad chemical interest, and a beginning was made at Lyon with addresses by Prof. L. Vignon, on the early history of dyestuff manufacture in Lyon, and by Prof. Perrin, on the discontinuity of matter. It is proposed that henceforth a series of addresses, devoted to broad chemical problems, not matters of detail, shall be presented for discussion at each annual meeting.

The following officers of the Union were elected for a period of three years:—President: Sir William Pope; Vice-Presidents: Prof. W. D. Bancroft, Ithaca; Prof. E. Billmann, Copenhagen; Prof. E. Paterno, Rome; Prof. E. Votocek, Poland; General Secretary, Jean Gerard, Paris. At the conclusion of the Conference it was decided to hold the Fourth International Chemical Conference in Cambridge, England, from June 17 to 23, 1923.

The Committee at Lyon created an admirable organisation for facilitating the work and promoting the comfort of the delegates; numerous visits to works of a most interesting and instructive character were arranged and the delegates were entertained most hospitably at many social functions. The proceedings terminated with a banquet offered by the Chamber of Commerce of Lyon.

At the close of the Conference, many delegates left by special train for Marseilles to attend the opening of the second congress held by the Société de Chimie Industrielle.

MEETINGS OF OTHER SOCIETIES

BRITISH PHARMACEUTICAL CONFERENCE

The fifty-ninth annual meeting was held in University College, Nottingham, from July 24 to July 27 under the presidency of Prof. H. G. Greenish, who delivered an address upon "Pharmacognosy and the Pharmaceutical Curriculum." Pharmacognosy, he said, was a field of knowledge that the pharmacist was peculiarly fitted to cultivate provided he had received a sound scientific training. The training in pharmacognosy should be of a more general and practical nature than was at present often the case, and should include the determination of diagnostic characters by means of the lens or microscope or by qualitative chemical tests. A detailed syllabus, however, was disadvantageous as it restricted freedom of thought and the development of that spirit of inquiry which was essential to progress. In the advanced course of instruction and in the Major examination, more stress should be laid upon the identification of powdered drugs, the analysis of mixed powders and the assay of drugs by chemical methods. Opportunity for postgraduate work was very necessary and every inducement should be offered to the student to undertake it. The Universities of

Manchester and Glasgow had accepted pharmaceutical subjects as part of the examination for the degree of Bachelor of Science, and if the University of London could be induced to do the same a considerable step forward would be made. The student who had attended advanced courses of instruction could take the degree of B.Sc., and then proceed without difficulty to the degree of Doctor of Philosophy, the requirement of the University of London being broadly two further academic years of study and the presentation of a thesis on an approved subject. The field of pharmacognosy was so wide and the problems awaiting solution so diversified in their nature that there would be no difficulty in selecting subjects suited to the varied abilities of the students. Great assistance would be rendered in this work by the establishment of an experimental station similar to the Pharmaceutical Experimental Station of the University of Wisconsin at which the material necessary for investigation could be grown and experiments carried out. The determination of the Pharmaceutical Society to foster its scientific work more in the future was one of the most hopeful signs for the future of pharmacy, and would assist the Society in establishing its position as a learned society.

In a paper entitled "A Contribution to the Study of *Strophanthus*" Dr. K. Saaman described a variety of *strophanthus*—*Strophanthus preussii*—from Southern Nigeria, and showed that whereas this drug acts powerfully on the heart, it has a comparatively negligible action on the blood vessels.

Mr. T. E. Wallis contributed a paper on "Some Characteristics of Wheat Starch." Since wheat starch closely resembles barley starch it is difficult to identify either starch in mixtures of the two. The author's experiments indicate that wheat starch can be identified by measuring the diameter of the largest grains, which vary in diameter from 15 to 45 microns, reaching a maximum of about 50 microns, whereas those of barley never exceed 40 microns, so that if the starch contains any number of grains measuring 40 microns and over the presence of wheat starch is established.

Prof. Greenish and Miss C. E. Pearson presented "A Note on the Occurrence of Santonin," in which they reported upon the examination of several species of *Artemisia* suggested as possible sources of santonin. *Artemisia brevifolia* from Gurez was found to contain about 1 per cent. of santonin, but a sample of "estafiate" sent from Mexico consisting of two distinct species of *Artemisia* (*A. mexicana*, Willd. and *A. redolens*, Willd.) and samples of *A. Abrotanum*, Linn., and *A. vulgaris*, Linn. contained none.

A paper on "The Extraction of Quinine and Strychnine from Solutions of Varying Hydrogen Ion Concentration" was read by Mr. N. Evers, who described a method for separating strychnine from quinine based upon the fact that strychnine may be completely removed from a twice normal solution of hydrochloric acid by chloroform, whereas quinine is only removed to a very slight extent. The determination of Easton's syrup requires much less time with this than with other methods.

A detailed study of "The Rapid Estimation of Quinine Salts in Tablets" was presented by Messrs. S. G. Liversedge and F. W. Andrews. Mr. C. W. Gosling described in detail the Michell

viscometer, and other contributions included:—"A Further Note on the Ether-Solubility of Scammony Resin," by H. Deane and W. E. Edmonton; "A Note on Acetum Scillae" by J. H. Franklin and G. G. Hammond; "A Note on a Ferrocyanide Coloration of Tincture of Chloroform and Morphine B.P. 1885," and "A Note on Cherry-Laurel Water," both by C. M. Caines.

BRITISH ENGINEERING STANDARDS ASSOCIATION

The fourth annual meeting was held on July 13 in the Institution of Civil Engineers. The Chairman, Sir A. Denny, in presenting the annual report said that nearly 2000 engineers now gave their time and experience to the Association. During the past year 72 new and revised specifications were issued and 39,000 publications sold, in addition to a large number of aircraft specifications distributed for the Air Ministry. Expenses totalled £17,000, of which industry, despite trade depression, contributed £9300, the remainder coming from the Government, the India Office, and the Governments of the Dominions overseas. After reviewing the work of the various sections of the Association Sir A. Denny asked for more financial support from industry so that the Association could carry out work in hand and increase its activities in the future.

CORRESPONDENCE

THE CHEMIST AND THE MANUFACTURER

Sir,—The following random thoughts have been evoked by reading an article in the *Journal of Industrial and Engineering Chemistry* (Eller, June, 1922, p. 544), headed "Can the College do anything for Industry?" and dealing with the ever-green question of training the industrial chemist.

What is the ideal industrial chemist? Ask the professor. Ask the works manager. Widely divergent definitions would be advanced according to the standpoint of the one defining. The definition depends on the view taken as to the needs of industry. The professor's slogan is "Science," and the manufacturer's counter-cry is "Profits." It is left to the ideal industrial chemist to provide a common standing ground.

To the unbiassed, broad-seeing observer one of the wheels of industry's chariot must be chemical knowledge, and such wheels in the form of good, all-round chemists are to be obtained from the professorial wheel-wright. The owner of the chariot, that is the manufacturer, must, however, do his own fitting, and there must be a trial run to rub the bearings smooth. Reduction in running-costs must not be expected immediately.

A cause of disappointment may be that the manufacturer is not clear as to what he wants from his chemist. He appoints a chemist perhaps as he tries a new, much-advertised machine. He finds that the working is not quite so automatic as the advertisements claimed. It should be realised that the young graduate, although full of new knowledge and enthusiasm, inevitably requires some initial leading in the ways of industry. Failing a co-operative and sympathetic attitude from the

employer, there is very quickly an over-heated bearing, the chariot moves but slowly and science is condemned wholesale.

Narrowness of view is by no means confined to the employer of chemists. The University professor is, of course, essentially limited in outlook—at least according to the man of the industrial world. Goggled eyes are indispensable in his make-up in the caricatures; and he justifies the world's opinion when his students are let loose on the arid, stony plain of chemical manufacture, with the idea that the few short years of cloistered chemical study, and the possession of the coveted alphabetical handle to the name, are all that is necessary to cause the plain to bloom and blossom wherever they may go. No, it would be a move towards the ideal co-operation of manufacturer and chemist if the latter came from the University with the smallest opinion of his acquisitions, and the realisation that the first step in growing flowers of the industry and science strain is to clear the ground of stones. The stones are the manufacturer's doubt, distrust and lack of sympathy with the aspirations of science. Can these be removed? Doubtless it is generally a long and tiring process, but possibly judged worth while by those fortunate ones who have now arrived at the flower-gathering season.

In conclusion, the moral now appears. Manufacturers, tell your chemist clearly what you want of him, and use him to the full extent of his abilities. Universities, broaden your teaching and outlook, scrap the goggles. It might then be found that the college *was* doing something for industry.—I am, Sir, etc.,

ALAN A. DRUMMOND.

Iver, Bucks.
July 25.

PERSONALIA

Dr. M. O. Forster has been appointed director of the Indian Institute of Science, Bangalore, and will take up his new duties early in November.

Mr. J. F. Smith has been appointed director of research to the Commercial Solvents Corporation, United States.

Dr. G. Senter has been selected by the University of London Graduates' Association as candidate for the vacancy in the representation of science graduates on the Senate of the University of London.

Dr. T. M. Legge, of the Home Office, and Dr. S. Miall have been appointed the British representatives on the advisory committee on industrial hygiene of the International Labour Office.

The Trustees of the Beit Scientific Research Fellowships have re-elected Mr. H. L. Riley and Mr. W. A. P. Challenor to fellowships for the year 1922-23 and elected Mr. H. W. Buxton to a fellowship for the same period. The fellowships are tenable at the Imperial College of Science.

The Italian Ministry of Industry has appointed Professors M. G. Levi, Nasini, Parravano, and Scarpa to be members of the permanent Committee for the Italian Chemical Industry (*cf. J.*, 1922, 9 n). Prof. G. Varino has been appointed president of the Royal Technical Institute in Mantua.

Dr. P. Riebensahn has accepted the post of professor in charge of the metallurgical institute of the Berlin Technical *Hochschule*; Dr. H. Meerwein has succeeded Prof. H. Klinger in the chair of chemistry in Königsberg University; Prof. Wilke-Dörfurt has accepted the professorship of pure and technical chemistry in the Stuttgart Technical *Hochschule*; and Prof. E. Terres, of Stettin, has been awarded the prize of the German Bunsen-Gesellschaft for his researches in inorganic chemical technology, carried out in the Karlsruhe Technical *Hochschule* and published during 1920-21.

* * *

All will regret the death, at the age of 75, of Dr. A. Graham Bell, the inventor of the telephone.

Dr. Jokichi Takamine, a prominent Japanese chemist, has died at the age of sixty-seven.

The death is announced of Prof. F. Hofmeister, formerly professor of physiological chemistry in Strasbourg University.

The following deaths are announced from Germany:—Prof. H. Rubens, director of the Institute of Physics of Berlin University; Dr. K. Schaefer, professor of chemistry at Leipzig University; and R. Nöllenburg, founder of the Deutschen-Erdöl-A.-G.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The Deguide process for recovering sugar from beet molasses by means of baryta (*cf.* J., 1922, 244 R) promises to become increasingly important, as it is now proposed to utilise the baryta for defecating the raw beet-juice. In this way it will be possible to recover all the potassium and nitrogen compounds that pass into the extracted juice in the diffusion process. Apart from their monetary value, these salts constitute ideal fertilisers for the sugar beet, and their recovery might lead to an extension of beet-growing in France. The Société des Produits Azotés is now producing a new fertiliser, "phosphazote," which consists of superphosphate of lime and urea, the latter being obtained by hydrolysing cyanamide. Urea contains nearly 45 per cent. of nitrogen, compared with 15.5 per cent. in sodium nitrate, 20 per cent. in ammonium sulphate, and 35 per cent. in ammonium nitrate. According to MM. Matignon and Fréjacques, urea can be produced either continuously or discontinuously by heating ammonium carbamate in an autoclave to 150° C.; when the temperature has fallen to between 60° and 100° C., the resulting carbon dioxide and ammonia are drawn off and utilised again. Treated in this way 100 kg. of carbamate is said to yield 35 kg. of very pure urea that requires no further treatment.

Metallurgy.—The effect of the sudden depreciation of the mark has already been felt in the metallurgical market: French exports have diminished, and although Germany has great needs but cannot buy, she is once again in an ideal position for exportation. The French consumption of iron ore is satisfactory and the exports are directed mainly to Belgium and Luxembourg; Germany is now getting her supplies from Sweden as far as possible.

Great attention is being paid by the industrial world to "reparations" and inter-Allied debts. The only hope of a solution seems to lie in the application of the Wiesbaden agreement and of its extension, the Le Trocquer scheme, which proposes payment in kind and the use of German labour and raw material to carry out important public works in France. Of these schemes the chief are the harnessing of the Rhône, the Truyère and the middle Dordogne, the construction of a tunnel between St. Maurice and Wesserling, and of a canal to connect the Sarre, Moselle, Meuse and Meuse-Scheldt. Apparently, the great French metallurgical companies are not hostile to this solution, but wish to find how their own interests would be affected before approving it. Meanwhile the industry has to face the problem of increased costs due to the rise in price of metallurgical coke. At the end of June the price of metallurgical coke was 90 francs per metric ton, but rose to 93 fr. in July and will probably reach 97 fr., whereas selling prices of metallurgical products are falling steadily. If the cost of labour and transport also increase the industry will be forced to sell at a loss and a repetition of the financial crisis of last year will have to be faced. One impediment to a solution is that, in certain regions, labour is not only scarce but expensive, and, in addition, a reduction in railway rates is badly needed. The question of an agreement between the chief metallurgical firms in Allied countries is still in suspense, the chief obstacle to a decision being the attitude of the Belgian producers. In the meantime the Union Financière and the Union Métallurgique have decided to co-operate in exporting metallurgical products and action will probably be taken when business is resumed after the holidays.

AUSTRALIA

Copper Mining in Papua

Negotiations between the Commonwealth Government and the New Guinea Copper Mines, Ltd., are stated to be practically complete for the purchase by the former of the company's jetty and the railway connecting the Dubuna mine with the coast. The company, which will undertake to raise £100,000 for developing this mine, will connect the Laloki mine with the coast by an aerial ropeway and instal smelters at Bootless Inlet. As the ore contains 40 per cent. of iron and 40 per cent. of sulphur, it may eventually be shipped to Australia for use as a flux for siliceous ores. When the copper smelters on the mainland can take delivery, about 3000 tons of ore per month will be shipped.—(*Ind. Austral.*, May 4, 1922.)

The New Guinea Copper Mines, Ltd., was formed to take over the property of the Laloki (Papua) Copper Mines Co., situated near Sapphire Creek, not far from Port Moresby. The ore developed down to the 200-ft. level in the Laloki and Dubuna mines is estimated at 300,000 t., averaging 4.8 to 5 per cent. copper, 42 per cent. sulphur, and 2½ dwt. gold and 10 dwt. silver per ton. At 100 ft. below the 200-ft. level the ore averages 7 per cent. copper and there is evidence of the existence of other valuable ore-bodies. A smelting-plant with a capacity of 300 t. of blister copper per month is being erected and as the ore is pyritic contracts have been made to sell it to manufacturers of sulphuric acid.—(*Mining Mag.*, July, 1922.)

CANADA

The Asbestos Industry

The recent agitation for the provincial Government of Quebec to impose an embargo upon the export of raw asbestos has apparently died a natural death. The United States is the largest consumer of raw asbestos, which enters that country duty free, but there is a prohibitive tariff on manufactured asbestos products. The falling off in the demand for asbestos is reflected by the restricted mining operations in the Eastern Townships of Quebec. The prices of fibre have dropped from 25 to 60 per cent., and the competition from South Africa has cut into the sale of Canadian fibre in Europe. The South African mines have a much lower wage-scale. Russian fibre is also appearing on the market. Under present and prospective trade conditions some of the lower-grade mines may have to close, and the industry as a whole will have to be prepared to meet the competitive conditions of ten years ago. This should not offer great difficulty as both mining and milling methods have been improved since that period and, with competent management, Canada should retain the firm grip which it has had upon the asbestos trade.

The Alcohol Industry

Notwithstanding restrictive legislation the distilleries of Canada apparently are not idle. According to the report of the Dominion Bureau of Statistics for 1920, there were four distilleries in operation during that year, viz., two in Ontario and one each in Quebec and British Columbia. Invested capital amounted to \$11,773,046, salaries \$84,345, wages \$292,363, fuel costs \$141,304, materials cost \$1,210,633, and the value of products was \$2,815,359. Exports of distilled liquor in 1919 were valued at \$3,809,293, consisting of 1,455,707 galls., whilst in 1920 exports were 1,332,365 galls., valued at \$3,042,307. Imports of distilled liquor in 1919 amounted to \$426,201 and \$2,815,359 in 1920. In the latter year 2,223,428 galls. of non-potable alcohol, valued at \$1,595,584, was imported, compared with 651,396 galls., valued at \$227,988, in 1919. The production of distilled liquors in 1920 showed an increased value of \$2,389,158 over the preceding year. Both potable and non-potable alcohol show a greater output in 1920; potable spirits increased in quantity from 95,226 to 1,084,213 proof galls., whilst non-potable alcohol manufactured in 1920 amounted to 2,223,438, as against 651,396 proof galls. in 1919.

Miscellaneous

The Duffee Soap Co. is to erect a factory at Streetville, Ont., for the manufacture of soaps, and the B. and I. Laboratories Co. a plant for the manufacture of washing powders in Hull, Que.

The National Silk Dyeing Co., of Paterson, N.J., has purchased 13 acres of land at Drummondville, Que., for the erection of its Canadian plant.

The Quebec Legislature has passed a Bill empowering the interests which control the supply of electric power to Montreal to develop the great water-power at Carillon Rapids upon the Ottawa River, between Ottawa and Montreal. The associated companies (Montreal Railway, Heat, Light and Power Co. and Quebec Railway, Light, Heat and Power Co.) now control immense hydro-electric properties in the province and developments are awaited with much interest.

UNITED STATES

Zinc Production in 1921

The output of zinc in the United States in 1921 was 218,073 tons, valued at \$21,807,000, compared with 484,748 t., valued at \$78,529,000, in the previous year; consumption fell from 323,043 t. to 203,600 t., and the number of retorts in operation at the end of the year was 42,400, a decrease of 13,600. The output of rolled zinc diminished by nearly one-half. Imports, which have been negligible since 1915, increased very considerably.—(*Schweiz. Chem.-Z.*, May 30, 1922.)

The Dye Embargo

During the discussion in committee on the tariff Bill, the Senate rejected the clause extending the embargo on dyestuffs for one year after the Bill becomes law. This rejection is believed by representatives of the dye and chemical industries to be due to the Government's action in demanding the return of the German patents sold by the Alien Property Custodian to the Chemical Foundation (*cf. J.*, 1922, 311R). An attempt will be made, however, to reverse the decision when the Bill comes before the Senate proper after the committee stage is passed.—(*Oil, Paint and Drug Rep.*, July 24, 1922.)

BRITISH INDIA

Glue Manufacture in Madras

The manufacture of glue on a commercial scale has been started at the experimental glue factory in Madras, and the output is about 2 cwt. per day of excellent glue, priced at 55 rupees per cwt. at the factory. Glue of special quality can be manufactured to meet specific requirements.

Preparation of Odourless Spirit

Ordinary rectified spirit possesses, besides the smell of alcohol, an odour characteristic of the raw material used in its manufacture. As spirit possessing this extraneous odour is objectionable for use in preparing perfumery, Prof. A. C. Sircar and S. C. Deb have worked out three methods for deodorising rectified spirit obtained from *mahua* flowers or molasses. The methods used were, briefly, as follows:—(1) Four c.c. of a solution of 12 g. of potassium permanganate in 100 c.c. of water was added to 1 litre of the spirit and the mixture kept for two days. The alcohol was decanted from the black precipitate that had formed, kept over quicklime overnight, and then distilled. Recovery of alcohol was about 85 to 90 per cent. by volume, and the sample had a sp. gr. of 0.788 at 33° C.; a sample of odourless ("silent") spirit had a sp. gr. of 0.794. (2) One litre of alcohol to which 10 g. of caustic potash had been added was kept overnight, boiled under a reflux condenser for 1 hr. next day, then distilled, kept overnight over quicklime, and finally re-distilled. The recovery was about 88 per cent. by volume. (3) A 250 c.c. sample was filtered 8 times through 4 g. of porous charcoal made from flax stems, and then through 4 g. of purified animal charcoal. The specific gravity of the product was 0.82. Samples were examined by the Industrial Chemist to the United Provinces and found to satisfy the requirements of a "silent" spirit and to compare favourably with foreign samples.—(*J. Ind. Indust.*, May, 1922.)

GENERAL

The Rubber Research Association

The new laboratories of the Research Association of British Rubber and Tyro Manufacturers at Croydon were opened on July 26 by Lord Colwyn in the presence of a representative gathering. Lord Colwyn, in declaring the laboratories open, observed that the ability of the industry to compete in the world's markets depended largely upon research, and Mr. A. Johnston, of the North British Rubber Co., who presided, said that although the value of the world's output of rubber goods was £350,000,000, the industry might still be regarded as in its infancy; he was confident that both the producing and manufacturing branches of the industry would soon regain their former prosperity. The new laboratories, which are under the charge of Mr. B. D. Porritt, contain, in addition to administrative offices and a library, laboratories for physical, chemical and special work, a miniature factory equipped with machinery for preparing and vulcanising rubber, a mechanical testing-room, a workshop, etc. The site is conveniently situated and there is ample space for future extensions.

Consumption of Rubber

The excess of imports over exports of rubber in the chief consuming countries was as follows in 1913, 1920 and 1921:—

	1913	1920	1921
		Metric tons	
United States ..	53,092	264,962	191,700
England ..	27,315	61,398	45,514
Germany ..	16,525	12,095	20,756
France ..	5,751	16,031	15,064
Japan ..	1,265	5,558	22,500
Canada ..	2,116	12,035	9,000
Italy ..	2,546	6,222	5,000
Belgium ..	3,588	3,500	3,000
Sweden ..	1,039	1,592	826
Norway ..	338	245	193
Denmark ..	130	508	258

As is well known, the United States is the greatest user of raw rubber, and of the goods manufactured therewith about 70 per cent. consists of tyres, 14 per cent. of footwear, 10 per cent. of technical products and 6 per cent. of miscellaneous goods. The demand from Russia, which was about 11,600 t. in 1913, fell to only 500 t. in 1920. Imports of raw rubber into Germany during the 10 months ended February, 1922, exceeded the total imports in 1913.

Standard Dimensions of Iron Pipe Fittings

The British Engineering Standards Association has issued two new reports, No. 143, and No. 154, which set out the British standard dimensions for malleable and soft cast-iron pipe fittings of nominal sizes from $\frac{1}{2}$ in. to 4 in. and suitable for steam, water and gas. Both of the reports contain details of special sizes of reducing fittings, definitions of screw threads, methods of specifying outlets, and tables of dimensions of standard equal and reducing fittings as well as special tables for ascertaining the centre-to-face dimensions of reducing fittings. Type drawings of the fittings are given, in addition to a diagram illustrating the method of setting out curves for reducing fittings. Report No. 143 is limited to fittings (bends, elbows, tees and crosses) designed for use where the maximum "delivery head" is needed and where the frictional resistance has to be considered, whereas No. 154 is devoted to all fittings in general use. The reports, priced at 1s. each, may be obtained from the offices of the Association, 28, Victoria Street, London, S.W. 1.

Silver and Tin in 1921

The following statistics of production, imports and exports have been compiled by the Imperial Mineral Resources Bureau:—

		SILVER	
			Fine oz.
United Kingdom	Imports	Silver bullion, unrefined	5,787,244
		Silver bullion, refined	40,245,164
		Silver coin, of legal tender in U.K. (Face, or currency value) ..	(£1,525,520)
		Silver coin, not of legal tender in U.K. (Value of commodity) ..	(£1,303,454)
Northern Rhodesia	Production		8,866-71
Southern Rhodesia	Production		152,098-80
Union of S. Africa	Production	Silver in gold bullion ..	821,037-48
Canada ..	Production Exports	Silver in other minerals	9,291-616
		Silver	13,134,926
		Silver in ore, concentrates, etc. ..	1,537,080
		Bullion	7,258,954
India ..	Imports		55,919,954
Australia ..	Production	In lead and zinc concentrates, in other ores and concentrates treated in Australia or exported and in gold bullion treated at Australian mints	8,326,006
		Refined silver produced in Australia, and metal in unrefined products, ore and concentrates exported ..	5,304,950
		Bar, ingot and sheet ..	2,711,729
		Silver contained in matte	58,860
		Silver contained in ores and concentrates ..	667,261
		Beaten, drawn, rolled and thread ..	89,184
		Crude, in ingots ..	3,994,187-40
		Coin	368,889-10
		Beaten, drawn, rolled and thread ..	1,303,489-60
		Crude, in ingots ..	6,576,756-40
		Coin	1,626,693-55
		Ore	(9 long tons)
Italy ..	Production	Silver	199,330
Mexico ..	Production		64,465,347-45
United States	Production		50,364,389

		TIN	
			Long tons.
United Kingdom	Production Imports Exports	Cornwall only	700
			20,967
			9,900
		Ore	12,423
Nigeria ..	Production		4
Southern Rhodesia	Production		1,408
Union of S. Africa	Production	Metallic content ..	920
S.W. Africa	Imports Exports Production		124
			1,678
		Ore	156
Prot'cte Swaziland	Production	Cassiterite	383
Federated Malay Sta.	Exports	Tin and tin contained in ore	34,489
India ..	Imports Exports		2,656
		Ore	81
Australia ..	Production		2,650
	Exports	Refined tin produced in Australia, and metal in ore and concentrates exported	2,990
		Refined tin	1,704
		Tin in ore and concentrates exported ..	6
			1,731
Belgium ..	Imports	Ore	358
France ..	Imports Exports	Metal	6,998
			27
		Metal	606
		Ore	2,273
Germany ..	Imports	Crude metal	130
Norway ..	Imports	Ore and oxide ..	13,696
United States	Imports Exports	Bars, blocks, pig or granulated	24,197
			1,031
		Pigs, bars, etc. ..	17,414
		Ore	
Bolivia ..	West Coast shipments		8,500
China ..	Production		12,125
Banka ..	Production		
Billiton and Singkep	Production		7,000

Beet-Sugar Production in Europe

According to the Sugar Statistics Bureau Licht, of Magdeburg, the European production of beet sugar in the seasons 1920-21 and 1921-22 was as follows:—

	1920-21	Metric tons	1921-22
Germany ..	1,109,119	..	1,320,000
Czechoslovakia ..	713,165	..	650,000
France ..	336,960	..	300,000
Holland ..	317,196	..	335,000
Belgium ..	242,589	..	300,000
Austria ..	14,000	..	16,000
Hungary ..	33,000	..	52,000
Denmark ..	137,000	..	145,000
Sweden ..	182,458	..	253,000
Italy ..	138,000	..	230,000
Spain ..	238,000	..	118,000
Poland ..	171,000	..	205,000
Other countries ..	160,000	..	180,000
Total ..	3,792,487	..	4,104,000

The German beet-sugar industry is rapidly recovering, and it is anticipated that production for next season will increase by 500,000 metric tons. Beet cultivation in Holland and Belgium is increasing, Italy has changed from an importing to an exporting country, but the output of Czechoslovakia has fallen off and Poland can do little more than supply its own needs. As a result of the war France possessed only 80 beet-sugar factories at the beginning of the 1920-21 season, compared with 206 in 1913, and imports have risen from 115,057 t. in 1913 to 626,337 t. in 1920, the home consumption of refined sugar in a normal year exceeding 700,000 t. Many of the factories now under restoration are being equipped with modern plant, so that costs of production will eventually be lowered and the French sugar market strengthened. Apparently nothing has been done to restore the Russian beet-sugar industry; but the factories are believed to be intact.—(*U.S. Cem. Rep.*, Apr. 10, 1922.)

REPORTS

ANNUAL REPORT OF THE CHIEF INSPECTOR OF FACTORIES AND WORKSHOPS, 1921. Pp. 131. London: H.M. Stationery Office, 1922. Cmd. 1705. Price 3s. net.

As the industrial situation throughout the past year has not encouraged trade developments, those developments which did take place are of particular interest. They include the introduction of a new type of gas-producing plant which yields an output equal to that of four ordinary producers but with reduced expenditure upon coal and labour, the erection of new steel rolling-mill plant and electric furnaces in Sheffield, and the production of a stainless steel which is ductile and can be worked cold into articles of intricate shape. The introduction of an untarnishable metal resembling electro-plate and described as synthetic silver-nickel is also mentioned. Grinding operations in the cutlery trade have also been greatly improved and new factories have been erected for the manufacture of plate-glass, matches, formic acid, hydrogen peroxide, lanoline from wool grease, and cement, and for refining edible oils. The only trades which have been fully occupied are those connected with the manufacture of food, confectionery, hosiery and high-class cloth. Of late, however, manufacturers have reported that, with orders for both home and foreign markets coming in, the outlook is brighter. Further progress has been made in the standardisa-

tion of safety precautions in certain industries. The Inspectors in the Engineering Branch have conducted special inquiries in connexion with the draft codes of regulations for chemical works, the manufacture of aerated waters, india rubber, and electric accumulators, and the handling of hides and skins. Other inquiries have related to the dangers incident to repairs to oil-tank steamers, the competency of certain persons to examine steam boilers, and explosions due to dust, metallic powders, and volatile substances. Revised pamphlets describing the dangers from carbon-monoxide poisoning and from the use of acetylene have been issued. Amongst new Orders and Regulations made during the year are those relating to the manufacture of lead compounds, aerated waters, and celluloid. The Departmental Committee on the Prevention of Anthrax has reported that the process devised for disinfecting wool is also suitable for disinfecting horsehair. Another committee is re-examining the question of the danger of the use of lead paints.

The number of registered factories during 1921 was 142,749, an increase of 2685 over the previous year; the number of workshops was 156,123, 4944 fewer than in 1920. The number of reported accidents was 92,565, of which 951 were fatal. The remarkable decrease in the number of accidents reported is almost entirely due to inactivity in industry. The statistics reveal a striking proportion of accidents due to "falling bodies" and to "persons falling." Detailed descriptions are given of a number of accidents arising from mechanical appliances and additional precautions suggested. Two dust explosions resulted in accidents during the year, one of metallic aluminium powder in a rotary sieving machine and the other of dust in the hopper under the rolls of a malt mill. Both were probably caused by sparks from foreign bodies admitted to the mechanism. A fatal accident resulted from the explosion of a mixture of copper oxide and a powdered aluminium alloy containing copper and zinc. The ignition was started by sparks falling from a crucible, and the violence of the explosion may have been due to the presence of ammonium nitrate as an impurity in the powder or to overheating in a preparatory drying process. In the chapters on Dangerous Trades, Health and Sanitation, and Welfare, reference is repeatedly made to the importance of cleanliness and of efficient ventilation.

During the year there were 230 cases of lead poisoning, 1 of arsenic poisoning, 1 of toxic jaundice caused by arseniuretted hydrogen, 32 of epitheliomatous ulceration, 29 of chrome ulceration, and 25 of anthrax. No cases of phosphorus or mercury poisoning were reported. In connexion with lead poisoning attention is directed to the risks run in cutting up painted steel plates by means of the oxy-acetylene flame on account of the volatilisation of lead. Men employed in cutting up galvanised plates were found to be suffering from "brassfounder's ague" due to the presence of zinc oxide in the fume evolved. There were 77 cases of carbon-monoxide poisoning; in the treatment of these cases there is still difficulty in making rescuers understand the importance of rest. The results are recorded of medical investigations of illness caused by naphtha fumes, aniline, and paranitraniline. Three of the cases of epitheliomatous ulceration among tar workers occurred in stokers exposed to fumes on

the top of gas-producer plants to which coal was being charged.

The report includes separate chapters of general interest devoted to the Generation and Use of Electricity, Employment, Truck, Underground Workrooms, and Conditions in the Glass Industry.

REPORT ON THE COMMERCIAL AND FINANCIAL SITUATION IN BULGARIA, DATED JANUARY, 1922. By F. J. R. ROBB, *Late H.M. Commercial Secretary, Sofia. Department of Overseas Trade.* Pp. 13. London: H.M. Stationery Office, 1922. Price 6d.

It is anticipated that when statistics of the trade of Bulgaria during 1921 become available they will show an adverse trade balance, as they have done since 1908, except in the war years 1915, 1916, and 1917. The Bulgarian Government has been unable to negotiate either a foreign or an internal loan since the armistice, and the financial position is accordingly poor. Conditions have been unfavourable to importers of foreign goods, especially from countries with an appreciated currency. Thus Czech, German and Italian firms have secured much business and the contract for supplying copper sulphate to the Agricultural Bank, which had always been given to a British firm, has gone to Italy. There is little hope of improving the Bulgarian market for British goods, but a certain volume of trade, especially through Government contracts, will continue. Exports were fairly satisfactory, and would have been better but for the restrictions on exports of grain and timber. The rose-oil crop was good, and although the tobacco crop was 40 per cent. below the 1920 harvest, export was satisfactory. No important industrial developments have taken place, and the mineral resources remain entirely undeveloped, the only output of importance coming from the State coal mines, which produced 732,671 tons in 1920 and 397,496 t. during the first half of 1921. The few Bulgarian industries have not done well, largely owing to excessive taxation and to Government intervention.

REPORT ON THE COMMERCIAL AND INDUSTRIAL SITUATION OF HUNGARY, DATED MARCH, 1922. By R. J. E. HUMPHREYS, *H.M. Commercial Secretary, Budapest. Department of Overseas Trade.* Pp. 38. London: H.M. Stationery Office, 1922. Price 1s.

Although Hungary is handicapped by heavy debts, an adverse trade balance and a greatly depreciated and unstable currency, it has passed through the critical period of 1921 remarkably well and much improvement is observable in comparison with 1920. Owing to the drought, the fodder, beet and potato crops were poor, but the cereal crops were above the average and high export prices were realised. Of the industries based on agriculture, the milling industry, able to grind 750,000 tons of cereals annually, worked well below capacity, and although the 16 beet-sugar factories can produce 245,000 t. of sugar per annum, the poor harvest made it necessary to import sugar from Czechoslovakia. Alcohol is now being exported, the production exceeding the demand. Coal-mining, which follows agriculture in order of importance, made progress in 1921 and only 650,000 t. out of the 6,756,622 t. consumed had to be imported; with one exception (Pecs), the

Hungarian mines produce only brown coal, so that some importation is essential. Mining other than coal-mining does not exist in Hungary, and all the iron ore required in the large iron and steel industry is imported; this industry is now stagnant and development is unlikely until iron ore can be imported freely (*cf. J.*, 1921, 279 R). A revival in the leather industry is expected and several new factories are being built.

Imports during 1921 amounted to 2,330,000 metric tons, an increase of 300 per cent. over the previous year, and included over 72 per cent. of manufactured articles, the chief of which were valued as follows (million korona):—Mineral oil, refined, 664.7; pharmaceutical articles, perfumes, 97.4; candles, soap, 44.8; fuel 180.4; chemicals 383.3; glassware 511.5; stoneware 202.3. The value of the korona, 10d. at par, fluctuated between 0.28d. and 0.8d. in 1921. The imports came, as in pre-war times, mainly from Austria, Czechoslovakia and Germany, and only to a small extent (about £300,000 worth) from Great Britain, although British goods are included in the imports from Austria. All kinds of manufactures—textiles, leather, iron and steel, glassware—are required by Hungary, but trade cannot be re-established so long as the Succession States adhere to their policy of restrictions and until transport is greatly improved. Exports, amounting to 840,000 t., or 60 per cent. more than in 1920, consisted almost entirely of agricultural products.

REPORT ON ECONOMIC CONDITIONS IN RUMANIA, REVISED TO APRIL, 1922. By A. ADAMS, *H.M. Commercial Secretary, Bucarest. Department of Overseas Trade.* Pp. 62. London: H.M. Stationery Office, 1922. Price 2s.

The industrial situation of Rumania has changed very little since the last report was issued (*cf. J.*, 1921, 412 R), but a new customs tariff has been introduced which aims at protecting local industries. Cereal crops suffered from drought during 1921 and the yields of wheat and maize were low; probably wheat growing will diminish because the land has been subdivided among peasant owners. Apart from agriculture, petroleum production is the chief industry, the output in 1921 amounting to 1,163,780 tons from 690 wells, as compared with 1,034,123 t. in 1920 and 1,885,225 t. in 1913. About 70 per cent. of the output is sold locally at very low prices and as the depreciated exchange neutralises the benefit of high export prices, the development of the industry is handicapped by lack of capital. Production is not likely to increase owing to deficiencies in transport by both pipe-line and rail and to heavy export duties. A detailed account of the petroleum industry is given in an appendix.

Coal is mined chiefly in the Lower Carpathians and the output, now about 150,000 t. per month, is not large. About 350,000 t. of industrial coal and coke was imported before the war, principally from the United Kingdom, but importation has now practically ceased and the consumption of fuel oil is increasing as a consequence. In view of the application of protective duties, it is suggested that British manufacturers should start producing in the country. There are nearly 18 million inhabitants and the purchasing power of the population already shows signs of increasing. Detailed statistics of

Rumanian trade during 1921 are not available, but it is probable that there was a large adverse trade balance. During the year United Kingdom exports of manufactures to Rumania were valued at £5,432,855 and imports from Rumania at £3,359,386. The export trade of Rumania is hampered by transport deficiencies and the import trade by wide fluctuations in the value of the currency.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Trusts and Combines

Sir W. Mitchell-Thomson, replying to Mr. Waterson, said that the subject of trusts and combines was still under consideration, but no undertaking to introduce legislation could be given.—(July 20.)

Cocaine

In a written answer Mr. Shortt informed Dr. McDonald that licensed importers of cocaine had to keep records of their sales for inspection. The records did not show how the drug was distributed, as it might pass through several hands before being used.—(July 24.)

Poison Gas

The Prime Minister informed Mr. L. Malone that the United States War Department had discontinued the manufacture of poison gas for equipping the U.S. Army for gas warfare, but Congress had sanctioned the continuation of research and experimental work on poison gas. The proposed expenditure on preparing gas-warfare in this country in 1922-23 was £169,700, which covered research on protective measures against gas attack. Except small quantities for the research work, no poison gas had been manufactured in this country since the Armistice.—(July 24.)

Replying to Mr. Foot, Sir R. Sanders said that eight full-time and four part-time employees were engaged in the preparation of, or research on, poison gas, at an estimated total cost of £8000, not including the staff and expenditure for research on protection against gas attack.—(Aug. 4.)

Duty on Nigerian Palm Kernels

Answering Dr. Murray, Mr. Churchill said that the average price of palm kernels in Lagos was about £11 per ton in May and the export duty £2 per ton, i.e., about 18 per cent. of the average price at that time.—(July 25.)

British Dyestuffs Corporation

In answer to Rear-Admiral Adair, Sir W. Mitchell-Thomson said that he had seen an article on the dyestuff situation by Prof. H. E. Armstrong, suggesting that the Government should either withdraw its control of the Corporation or insist that the business should be managed by persons with technical qualifications. The Corporation was not controlled by the Government, whose interest in it was limited to a large holding of shares; he did not think it expedient to withdraw that interest. The proceedings at the last annual meeting showed that the directors were supported by the majority of the shareholders, and particularly

those representing the important consuming interests.—(July 26.)

Coal Exports to the United States

Replying to Mr. W. Thorne, Mr. Bridgeman said that orders from the United States had caused an increase in the price of certain grades of coal and an appreciation of certain colliery shares, but he was not aware of any contract placed in South Wales by the American Shipping Board; neither did the orders from the United States amount to nearly as much as 500,000 tons.—(July 27.)

Benzol Production in the United Kingdom

Sir P. Lloyd-Greame observed, in answer to Mr. Kiley, that the quantity of benzol produced by members of the National Benzol Association during 1921 was estimated at 9 million gallons, whereas non-members produced about one-quarter of that amount. Owing to the coal stoppage production was greatly reduced during 1921, and the present normal output was about double that attained in that year.—(July 28.)

Prices of Lime Green

Answering Lieut.-Com. Kenworthy, Sir P. Lloyd-Greame said the National Federation of Paint, Varnish and Colour Manufacturers had informed him that whereas the German prices of the cheaper grades of lime green were about one-half those of equal grades of British make, the difference decreased as the quality improved, British and German prices approximating closely for the highest grade. As the Federation had informed the Dyestuffs Advisory Licensing Committee that the difference in price did not materially affect the cost of finished goods containing lime green, he did not propose to ask the Committee to reconsider its decision not to grant import licences for this colour.—(July 31.)

Dyestuffs Industry

Sir P. Lloyd-Greame stated, in reply to Mr. Galbraith, that proposals for assisting the dye-making industry as a whole by further co-operation of the dye-users and the State were being considered by the Board of Trade and the Chancellor of the Exchequer.—(July 31.)

Distinctive Colours for Poisons

In answer to Sir F. Flannery, Mr. Shortt said that the practicability of employing distinctive colours for poisons such as arsenic and strychnine was being inquired into.—(July 31.)

Australian Zinc Concentrates

Replying to Mr. D. Davies, Sir W. Mitchell-Thomson said the moment was inopportune for raising the question of determining the contracts for future deliveries of Australian zinc concentrates. The estimated loss per ton on concentrates delivered in this country during the six months ended June 30 was £3 14s. 8d.—(July 31, Aug. 4.)

Stocks of Lead and Spelter

Mr. Bridgeman informed Mr. D. Davis that stocks of pig lead in the metal-exchange warehouses amounted to 263 tons and of spelter to 4662 t. on June 30, including Government stocks of spelter; stocks were also held by private firms.—(July 31.)

Morphia

Answering Viscountess Astor Sir J. Baird stated that, in 1920, 643,985 oz. of morphine was manufactured in England and 322,461 oz. of morphine and heroin exported (excluding amounts exported by post or in preparations).—(Aug. 2.)

Imports of Cement

In a written answer to Lieut.-Col. J. Ward, Sir P. Lloyd-Greame gave the imports of cement in 1920, 1921 and the first half of 1922 as 38,438 tons, 105,711 t., and 60,264 t., respectively.—(Aug. 3.)

Milk and Dairies (Amendment) Bill

The object of this Bill is to postpone until 1925 the operation of the Milk and Dairies Act, passed in 1915 and due to come in force on September 1, 1922, and to ensure the sale of clean milk. Thus Clause 4 prohibits the addition of water, colouring matter, or any dried or condensed milk or any fluid reconstituted therefrom, to milk, including skimmed and separated milk, intended for sale. Clause 5 prohibits the sale of milk from a cow suffering with a tuberculous udder and Clause 8 enables the Minister of Health to make Regulations for preventing danger to health from imported milk. In moving the second reading, Sir A. Mond said that he was considering methods of grading milk; the question of the standard of condensed milk was one of food value, but a standard such as a bacteriological count might be laid down.

Smoke Abatement Bill

This Bill proposes to amend the law relating to smoke nuisances by providing increased penalties for the emission of smoke, even if not black smoke, and of soot, ash, grit, and gritty particles from chimneys, not including those of private dwelling-houses. In proceedings for smoke nuisance, proof that the best practicable means was used for preventing the nuisance constitutes a defence. Power is given to the Minister of Health to extend, after consultation with the local authorities or other interests, the list of noxious or offensive gases and of works mentioned in the Alkali, etc. Works Regulation Act, 1906. Local authorities are empowered to require new buildings other than private dwelling-houses to be provided with heating arrangements calculated to prevent or reduce the emission of smoke. Two or more local authorities may combine to carry out their duties in respect of smoke nuisances and if a local authority fails to carry out these duties, the Minister may order the county council to carry them out.

Safeguarding of Industries Act

Order No. 1 under Part II.—In presenting the draft Order proposed to be made under Part II of the Act (*cf.* this issue, p. 339 R) Mr. Baldwin said that he had declined to make the Order apply to glassware from Czechoslovakia, as that country was making such efforts to stabilise its currency that any bounty it now derived from depreciation of the currency would soon cease. Amendments proposing to exclude glassware and hollow-ware from the Order on the ground that although German currency had depreciated, imports from that country had declined instead of increasing, were defeated. The Order was approved by 152 votes to 47.—(July 31.)

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Orders under Part II.—Action will be taken as rapidly as possible on any reports that may be received from Committees, but any Orders so made require confirmation.—(July 24.)

Glassware.—Evidence was given in public before the Committee on glassware that unemployment was being caused by importations of glassware, but it cannot be published for reasons of economy. The Board of Trade has no information suggesting that the imposition of a duty (under Part II) on German glassware would transfer the trade from Germany to Czechoslovakia. Glass jugs and tumblers are neither scientific glassware nor lamp-blown ware, and accordingly are not dutiable. Blanks for measure glasses are not held as dutiable, although glass articles such as pipettes and burettes, even when ungraduated, are still dutiable as scientific glassware or lamp-blown ware.—(July 24.)

Complaints.—Five complaints alleging dumping in the sense of Section 2 (1) (a) have been received since Part II came into force in August, 1921. Of these complaints, two have been referred to Committees, one was rejected, and two were referred back for further information.—(July 24.)

New Industries.—Since the Act came into operation the range of production of the branches of the chemical industry covered by the last heading of the Schedule has greatly developed and distinct progress is being made in respect of scientific glassware and optical and scientific instruments. There is no doubt that the Act has encouraged some manufacturers to keep in operation works that would otherwise have been closed down.—(July 24.)

"R" Commodities.—The Referee's judgment in the sodium hyposulphite case did not suggest that the exact scope and meaning of "R" should be defined in general, but that a more definite meaning was required in this particular case.—(July 24.)

Scheduled Articles.—One item has been added and seven removed from the list by direction of the Referee, and in consequence of the Referee's awards, 24 items have, on the responsibility of the Board of Trade, been deleted and the standard of the dutiable grade of 10 other scheduled chemicals has been raised. In nine complaints the Board's action was upheld by the Referee.—(July 24.)

Vulcanised Fibre.—No representations have been received from manufacturers of electrical apparatus that they depend on America for supplies of special qualities of vulcanised fibre.—(July 24.)

Gas Mantles.—The duty collected on dutiable ingredients of incandescent gas mantles up to July 1 amounts to £232. The Referee's award was not signed until May 17.—(July 25.)

Purity of Scheduled Chemicals.—Purity is not the only criterion used in deciding whether a chemical comes within the scope of Part I of the Act or not, as was shown by the Referee in deciding the sodium-hyposulphite case.—(July 31.)

Analytical Reagents.—Heavy chemicals are dutiable only when prepared in a state of special purity for use as analytical reagents.—(July 31.)

Sodium Pyrophosphate.—The Board of Trade is unaware that the Referee's decision respecting sodium pyrophosphate has injured the export trade of any company or has curtailed output and caused unemployment.—(July 31.)

Upon the adjournment of the House until November 14, the Royal Assent was reported to the Electricity (Supply) Act, 1922, and to the Milk and Dairies (Amendment) Act, 1922.

COMPANY NEWS

MOND NICKEL CO.—The eighth annual meeting was held in London on July 26, and Mr. R. Mond, who presided, said that the consumption of nickel for peace purposes had not yet attained the pre-war level. The outlook was not reassuring, but as trade revived prospects would improve, especially as new uses of the metal or its alloys were constantly being discovered and no efforts were spared in investigating new outlets. The nickel coinage adopted in Canada and Italy had proved so satisfactory that its use had been extended and it had also been adopted in other countries. With a view to extending the use of nickel the company had participated in the formation of the American Nickel Corporation, of Clearfield, Pa., which supplied malleable nickel to manufacturers of nickel goods and had been appointed the company's representative for the sale of raw nickel in the United States. Sales of copper sulphate had been almost normal in quantity, but the price had been kept low; and sales of precious metals had also been well maintained. Costs of production, though lower, were still too high, but no effort would be spared to maintain the company's strong position in the nickel industry.

The taxation problems of the company have not been finally settled, but figures are now available to show the financial position for the two years ended April 30, 1922. The profits for 1921 and 1922 were £222,630 and £299,041, respectively, and £610,383 (including £114,794 brought forward from 1920) remains for distribution; £220,000 was allocated for dividends paid for 1921 and an interim dividend of £110,000 on the preference and ordinary capital has been paid. A further sum of £87,500 is to be paid in dividends on the preference capital to make up the dividend to 7 per cent. for the year and £45,000 (1s. per share) on the ordinary capital, making a total for 1922 of £242,500; £110,000 has been provided for income-tax and £37,883 carried forward.

ANGLO-CONTINENTAL GUANO WORKS, LTD.—At the fifth ordinary general meeting, held on July 26, Mr. J. S. Holmes, who presided, said that the demand for fertilisers in the spring of 1921 was good both in the United Kingdom and in Europe, but the summer drought reduced the consumption, and Belgian and French makers of superphosphate, aided by the depreciated value of the franc, attempted to find a market in this country. Consequently, prices fell steadily, buyers were waiting until prices ceased to fall, and trade in the autumn was very poor, so that the total output of all the company's factories decreased greatly. Despite foreign competition, the demand was much better in 1922 and all the old stocks were cleared. Prices had been adjusted more closely to the foreign level, and if they remained stable an increased volume of trade should result in the winter. The profit from last year's trading was £32,364, which with a carry-forward of £9666, made a total of £42,030. The dividend on the preference shares absorbed £22,500 and that on the ordinary shares £14,000 (5 per cent.), leaving a balance of £5530.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for July 27 and August 3)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Belgium ..	Iron, steel, cement	122
..	Steel, pig iron	123
Canada ..	Pottery	87
..	Drugs	121
Colombia ..	Paper	116
Denmark ..	Heavy chemicals	94
" ..	Tinplate, blackplate	95
" ..	Iron, metals in ingots	96
France ..	Oils, tallow, chemicals, sugar ..	125
Holland ..	Chemicals (tender for)	16376/F.W./G.P.
Hungary ..	Rubber goods, drugs	103
New Zealand ..	Tinplate, galvanised sheets, steel, crockery ..	88
" ..	Sodium sulphide, cream of tartar, tartaric and citric acids, chemicals for druggists, refrigerating works, fell mongers and hide buyers, paper ..	89
Paraguay ..	Glass, glassware, pottery	225/64/F.G./M.C.
Sweden ..	Glass, glassware, pottery	225/1/F.G./M.C.
Switzerland ..	Copper sulphate, turpentine, linseed oil	111
" ..	Sugar, syrup	112

TARIFF CUSTOMS EXCISE

Bechuanaland, etc.—Proclamations have been issued restricting the importation into Bechuanaland, Basutoland and Swaziland of opium and other habit-forming drugs.

British India.—The tariff valuations for sulphur have been revised.

French W. Africa.—The "coefficients of increase" applied to imports of alcohol, potable spirits, alcoholic perfumery, etc. have been reduced from 2·5 to 1·5, the other "coefficients" remaining unchanged.

Germany.—A law has been passed authorising the reduction or suspension of the import duties under certain conditions. Cocoa products have been added to the export free-list.

Gold Coast.—Pharmaceutical preparations imported by medical practitioners and registered druggists are exempted from duty.

Greece.—Increased import duties have been applied to cocoa, vegetable oils, and plate glass, but those on coal-tar dyes, groundnut oil, ethers, etc. have been reduced. It is proposed to prohibit the importation for six months of certain cacao products and wares of glass.

Hungary.—From July 25 the surcharge when import duties on goods (not specified in lists "A," "B," and "C") are paid in paper currency has been fixed at 19,900 per cent., i.e., 200 times the nominal rates. The surcharges on goods in lists "A," "B," and "C" amount to 12, 40, and 80 times the nominal rates, respectively.

Italy.—The "coefficient of increase" applied to the duty on sugar that yields more than 94 per cent. on refining has been reduced from 1 to 0·7, i.e., the duty is reduced from 36 to 30·60 gold lire per 100 kg.

Norway.—Alterations in the customs tariff affect porcelain insulators, plate and sheet-glass (not including polished, bevelled, etc. glass or photographic plates), and iron sheets.

Rumania.—Importers of pharmaceutical products must show that the sale and manufacture of such products is sanctioned in the country of origin, furnish a certificate of their chemical composition, and state their therapeutic properties.

Sierra Leone.—The differential export duty on palm kernels has been abolished.

South Africa.—It is proposed to increase the customs duties on corks and stoppers made of mineral or vegetable material and on starch; to abolish the duty on scientific apparatus, glassware and porcelain made in the United Kingdom and reciprocating British Possessions; and to admit borax, boric acid, bromine, litharge, manganese dioxide, etc. duty free. Rebates of the duty on "plain spirits" are also proposed.

Switzerland.—All goods except scrap iron, and unmanufactured and coined gold may be exported under general licence. The restrictions on the importation of goods have been continued in force until June 30, 1923.

Tanganyika Territory.—The export duty on hides has been suspended until December 31. The prohibition of the importation of dyestuffs has been removed.

Trinidad.—Explosives (other than for industrial use), cocaine and opium may not be exported.

Tripolitania.—Import taxes are to be applied to alcohol, spirituous essences, sugar, and groundnuts.

United States.—The amendments adopted by the Senate to the Tariff Revision Bill are given in the issue for July 27.

GOVERNMENT ORDERS AND NOTICES

SAFEGUARDING OF INDUSTRIES ACT.—Part I.—In accordance with the Referee's judgment on the complaint relating to sodium hyposulphite, the Board of Trade has amended the lists of dutiable articles as follows:—For "R. Sodium hyposulphite" read "Sodium hyposulphite (photographic quality)." For "R. Sodium thiosulphate" read "Sodium thiosulphate (photographic quality)."

Part II.—The Board of Trade has issued the Safeguarding of Industries (No. 1) Order, 1922, under Part II of the Act. The Order, which came into force on August 8, imposes a duty of 33½ per cent. on, *inter alia*, unmounted domestic glassware, illuminating glassware (not including electric-lamp bulbs, miners' lamp glasses, oil-lamp chimneys, pressed glassware, or articles made of fused silica, vitreous or similar material), and domestic hollowware made of aluminium, or of steel or wrought iron, enamelled.

The committee appointed to inquire into complaints relating to glass bottles made in Holland and Germany has reported that the conditions laid down in Section 2 (1) of the Act are not fulfilled. Consequently the Board of Trade can take no further action in respect of the complaints.

INDUSTRIAL PROPERTY IN LUXEMBOURG.—In consequence of the accession of Luxembourg to the International Convention for the Protection of Industrial Property, an Order in Council has been made, applying the provisions of Section 91 of the Patents and Designs Act, 1907, as amended in 1914 and 1919, to Luxembourg from June 30. A copy of the Order may be consulted in the Patent Office Library, 25, Southampton Buildings, London, W.C. 2.

TRADE NOTES

BRITISH

Canadian Exports

According to the returns of the Department of Trade and Commerce, Canada leads the world in the value of exports per head of population. The returns show that Canada's exports now amount, in value, to \$150 *per capita*, as compared with \$65 for the United States and \$98 for the United Kingdom.

The exported value of Canadian products for the fiscal year ending March 31, 1922, was \$740,240,680, a decrease of almost 450 millions as compared with the preceding 12 months. The shrinkage, however, has been in value rather than in volume. The exports of paper and pulp make a useful illustration. In the fiscal year 1921, 14,363,006 cwt. of pulp, valued at \$71,552,037, whilst in 1922, 12,435,238 cwt., valued at \$35,924,877, were exported. The volume declined about one-seventh and the value about one-half. The export of newsprint in 1921 was 15,112,586 cwt., valued at \$78,923,137, whilst in 1922 there was a slight increase to 15,138,328 cwt., valued at \$64,635,627, or a shrinkage exceeding 14 million dollars. Agricultural products exhibit the same shrinkage in value, but an increased volume in many items.

FOREIGN

Imports of Chemicals into Lithuania

During 1921 Lithuania imported chemicals valued at 21,004,976 German marks, lubricating oil valued at 12,300,163 mk., and petroleum to the value of 15,366,530 mk.

German Trade in Colours, Oils and Fats

The extent to which the exports of colours, oils and fats from Germany have declined since the war can be seen from the following table, in which the exports are shown in 1000 metric tons and millions of marks:—

	1913		1920		1921 May-Dec.	
	1000 m. tons	MILL. mk.	1000 m. tons	MILL. mk.	1000 m. tons	MILL. mk.
Colours and colouring materials ..	262	272·9	101·5	3682·7	68·2	2505·0
Varnish lacquers, mas- tic ..	6·6	5·3	2·5	46·0	3·2	61·1
Mineral oils, etc. ..	117·0	8·3	25·8	82·0	25·3	91·9
Coal-tar, coal-tar oils, coal-tar products ..	250·2	32·1	67·7	207·7	140·0	348·1
Soap, candles, wax products ..	45·8	30·0	8·2	118·0	11·1	108·5

Statistics for the exports of colours during the first four months of 1921 are not available, but those for the rest of the year show an improvement

compared with the previous year. Colours and colouring materials play an important part in the export trade, and in 1920 represented 5 per cent. of the total value of the exports, viz., 69.5 milliard paper marks. There was also a slight recovery in the exports of oils, fats, varnishes, lakes, etc. during 1921. Exports of varnish, lakes and similar products during the first quarter of 1922 were as follows:—Lac varnish, spirit-free, asphalt, and other lacquers, 1059.3 t., 46.4 mill. mk.; sealing wax, 41.5 t., 1.7 mill. mk.; spirit varnishes, 31.4 t., 2.4 mill. mk.; oil varnish, varnish salt, birdlime, 129.3 t., 3.5 mill. mk.; mastic, 79.2 t., 1.2 mill. mk.; indigo and indigo-carmine lakes, 3638 t., 330.7 mill. mk.; ultramarine lakes, 217.4 t., 14.1 mill. mk. The destinations of the two last categories are shown below:—

	Jan.-Mar., 1922	
	Indigo Lakes	Ultramarine Lakes
	Metric tons	
Austria	—	5.0
Denmark	—	7.0
England	—	0.6
Baltic	—	13.0
Balkan States ..	—	3.0
Holland	58.7	—
Italy	21.2	—
Spain	18.4	53.5
Turkey	0.6	—
N. Africa	74.0	—
E. Asia	2971.2	18.2
Dutch E. Indies, etc.	250.5	—
S. America	—	27.7
Other countries ..	227.5	82.5

Imports of these commodities also declined. Thus the imports of colours, etc. fell from 74,860 t. in 1913 to 11,500 t. in 1920 and 3740 t. in 1921; those of varnishes, lacquers and mastic fell from 3520 t. in 1913 to 790 t. in 1920 and 390 t. in 1921; those of oils, etc. from 41,602,160 t. in 1913 to 11,139,890 t. in 1920 and 8,830,650 t. in 1921, and of soap, candles, wax, etc. from 45,750 t. in 1913 to 41,190 t. in 1920 and 15,330 t. in 1921.

Spanish Export Trade in Turpentine and Resin

The provinces of Old Castille and Segovia are the chief producing centres of turpentine and resin in Spain. Exports in 1918, 1919, 1920, and during the first four months of 1921, were as follows:—

	1918	1919	1920	1921 Jan.-Apr.
	Metric tons.			
<i>Turpentine:—</i>				
Belgium	—	1,024	1,737	487
England	344	1,481	110	—
France	1,379	597	1,010	—
Morocco	0.3	0.5	0.5	—
Other countries ..	613	586	217	31
<i>Pine-Tar:—</i>				
England	—	18	62	—
Italy	7.3	10	231	—
Switzerland	578	809	9	—
Other countries ..	73	470	249	36
<i>Resin:—</i>				
Germany	—	—	873	338
Belgium	—	4,902	6,066	1,018
France	1,921	937	261	1.8
England	961	4,567	2,039	298
Portugal	104	28	0.7	—
Other countries ..	2,664	2,573	2,330	288

The industry is controlled by the Union Resinera Espanola, one of the most important trusts in Spain. Some time ago German capital was invested in the trust and the Industria Resinera Ruth was formed with a capital of 50 million pesetas, of which 70 per cent. was provided by the Union Resinera. The Ruth company, which owns 23 factories equipped with modern plant, will manufacture not only resin products but also fish and olive oils, varnish, lakes, driers, colours, linoleum, glue, aniline and other chemicals, including synthetic camphor.

REVIEWS

CATALYTIC ACTION. By PROF. K. GEORGE FALK.
Pp. 172. New York: Chemical Catalog Co.,
Inc., 1922. Price \$2.50.

Catalysis has been the subject of not a few monographs recently, and one is tempted to anticipate some redundancy as additional books on this branch make their appearance. Prof. Falk's work, however, is to be heartily welcomed, because he deals with catalytic action on the basis of the simplest accepted principles of chemistry and examines the various current theories of catalysis from this standpoint, instead of considering each of the latter as more or less individual entities.

The result, even when one cannot perhaps accept the author's views in their entirety, is a very logical development of catalytic action, in which the relative importance of the subject itself and of the tentative theories put forward to account for it fall into due perspective with the fundamental principles of chemistry.

It is stated that the purpose of the book is to emphasise the *chemical nature* of so-called catalytic actions and that chemical (and also physical) relationships and laws which apply to chemical reactions necessarily must hold for catalytic actions.

The author's definition of the latter is an action in which the chemical composition of one of the final products of the action is the same as that of one of the initial substances: a formal statement of fact which has the advantage of being independent of the more involved "criteria" suggested by others.

An introductory chapter relates how the Berzelian classification of catalytic actions arose and sketches the history of the subject down to Ostwald's definitions of catalysis, with some stress on the manner in which, after Berzelius' time, this group of actions became rather the dumping-ground for chemical mysteries than a clear-cut subdivision.

Prof. Falk then applies his general "addition theory of chemical reactions" to catalysis; this postulates that the first step in a reaction is combination to form an addition compound. Hence he deals with catalysis in homogeneous systems from the viewpoint that the catalyst and reactants form an addition or intermediate compound, and with catalysis in heterogeneous systems on the basis that the first step is the formation of chemical compounds on the surface of the catalyst by the action of chemical forces.

The questions of mathematical expression of the rate of catalytic action, of the reaction velocity equations and of energy relations are then discussed, chiefly with reference to homogeneous systems, and subsequently enzyme action and contact catalyses are reviewed from the same standpoint.

Due restraint is shown in applying the ionic theory of electrolytic dissociation to action in aqueous media. The prevailing theories of electronic atomic structure, radiation, and adsorption (in Langmuir's sense, i.e., as due to chemical force) receive adequate attention, especially in reference to catalytic action at the surface of living cells and porous solids.

As already indicated, one is impressed by the fact that, starting from simple definitely chemical premises, not only does catalysis appear as a simple

special case of ordinary chemical action, but the physical and mathematical interpretation of the subject appears to be rendered more easy and more certain; moreover, it would seem unnecessary to restrict this method of approaching catalysis to the author's particular theory of the general mechanism of chemical reactions.

The general principles and arrangement of the work are thus entirely to be commended. The examples illustrating the development of the author's views, whilst on the whole well-chosen, might perhaps have been taken from a somewhat wider field; but this is, after all, largely a matter of personal opinion.

As regards catalysis in homogeneous systems, much stress is laid on Steiglitz's work on the hydrolysis of imino-esters, and it is shown that the results with imino-esters rather than with ordinary acid esters are more useful in the particular illustration in view. At the same time, one feels that the general argument would have been strengthened by appeal to a wider range of experimental work; and, perhaps, if no suitable data from American sources were available, it might have been well to scan the European literature more exhaustively than would appear to have been done!

Again, in dealing with contact catalysis, the only examples chosen from the very wide range of Sabatier's investigations are the decomposition of alcohols in presence of metals or metallic oxides and the similar decomposition of esters. The latter is a very complicated process with numerous possibilities of side-actions, and is not at the present stage sufficiently thoroughly investigated.

These minor points are mentioned only because it is felt that the general theory developed is worthy of even better exemplification than that which it has received, and not in any way in depreciation of the book. Professor Falk deserves the congratulations and thanks of chemists in general for his lucid, logical and straightforward exposition of his subject.

T. P. HILDITCH.

- (1) A TEXT-BOOK OF ORGANIC CHEMISTRY. By A. BERNTHSEN. *New edition revised to date by J. J. SUDBOROUGH.* Pp. xvi+908. London: Blackie and Son, Ltd., 1922. Price 12s. 6d. net. (2) DYES CLASSIFIED BY INTERMEDIATES. By R. NORMAN SHREVE. Pp. 631. New York: The Chemical Catalog Co., Inc., 1922. Price \$10 net.

(1) This revised edition of Bernthsen's well-known text-book is practically a new work. Although the arrangement is based on that of the older editions a great deal of extra material has been added, and Prof. Sudborough's claim that it has been brought up to date is fully justified. In addition to the incorporation of the results of recent research, new chapters have been added on the synthesis and degradation of ring systems, including a mention of spirans and cage systems, the organic compounds of arsenic, synthetic drugs, synthetic dyes and the chemistry of rubber. The thoroughness of treatment of the subject has, perhaps, rendered the book somewhat indigestible, but this seems nowadays an almost inevitable concomitant of works on organic chemistry. The laudable desire for compression has resulted in statements which may mislead a student by their brevity. For example,

in dealing with the formation of diazonium compounds no mention is made of the fact that some primary amines do not diazotise readily at 0° C., nor is the influence of negative substituents described. Again, it is to be inferred that benz-antialdoxime does not react with acetic anhydride as readily as the syn-isomeride and that in the latter case the nitrile is the primary product of the reaction. Moreover, the statement that acids transform the anti- into the syn-oxime is much too brief, as this occurs only under very special conditions and dilute acids bring about the reverse change.

The book is well supplied with references, particularly to more recent work, and these enable the student interested in a special subject to extend his reading to the original papers, an advantage so often missing in elementary text-books. It is to be regretted, however, that these references are interpolated in the text and not put as footnotes as they militate considerably against the ease of reading of the book. The printing is clear, the paper good though somewhat transparent, and misprints rare. The price is unexpectedly low considering the bulk and get-up of the volume, and it is to be hoped that the period of inflation of prices of chemical books is coming to an end. Students of organic chemistry will find this book a very sound investment.

(2) This volume represents a new classification of dyestuffs which will probably be of great use to the manufacturer as showing the dyes which can be prepared from the intermediates he has at hand, together with some indication of the demand for these particular dyestuffs as shown by the quantities imported and manufactured in the United States. The intermediates are arranged in alphabetical order, their formulæ given and their chemical name or names, the synonyms being cross-indexed in their alphabetical order. Where available, statistics are supplied of the amounts imported or manufactured in the United States in recent years. The methods of preparation of the intermediate are briefly indicated, together with references, and there follows a table giving the dyes, listed in Schultz's Farbstofftabellen, 1914 edition, made from the particular intermediate, statistics of their import and manufacture in the United States, the other intermediates used in their manufacture, and the class of dye according to the method of application.

At the end of the volume is given a formula index of intermediates, a glossary of dye names and an index of Schultz numbers. The list of intermediates is fairly complete and the book represents the results of much painstaking labour, though it would seem to have been worth the extra trouble to have given references to the originals rather than to other reference books such as Lange's Zwischenprodukte, Ullmann's Enzyklopädie or Barnett's Anthracene, etc. A few misprints are observable, particularly in the form of dropped letters, but on the whole the work is very free from typographical errors; the print and formulæ are very clear and the get-up of the book excellent.

The English reader, though he may find the book of considerable use for reference, will be disappointed to find that even in the glossary of dye names but few of the current American and British trade names are given, probably owing to the difficulty of obtaining information on the compo-

sition of dyes supplied under such trade names. It is open to doubt whether the secretive policy of British firms as regards the chemical constitution of their products is in the interest of the development of the dye industry in this country.

O. L. BRADY.

DICTIONNAIRE ANGLAIS-FRANÇAIS-ALLEMAND DE MOTS ET LOCUTIONS INTÉRESSANT LA PHYSIQUE ET LA CHIMIE. By R. CORNUBERT. Pp. 297. Paris: Dunod, 1922. Price, paper 42 fr., bound 47 fr.

The object of this dictionary is to enable French scientists to read works on chemistry and physics written in German or English, and thus open to them a wider range of scientific literature than could be obtained by confining their studies to their own language. There is thus nothing novel about the purpose of the author, and the book has to stand or fall by comparison with other similar dictionaries. The requirements that such a book has to fulfil are that it must be accurate, it must be reasonably complete, and it must be conveniently arranged for ready reference. It is essentially in the matter of arrangement that this book differs from most others of the same kind. It is not, as usual, in three parts; the author has arranged his vocabulary in three columns, in which the words in the respective languages are arranged in an alphabetical order applicable to all, a scheme which is generally possible, because the great majority of scientific terms are very much alike in all three languages; the words that run in true alphabetical order are printed in heavy type, equivalent words in the other languages that do not fall into this order being in ordinary type. For example, under the letter A we find *Ausschalter* in heavy type in the German column, the corresponding words in English and French, *cut-out* and *interrupteur*, being printed in ordinary type in their respective columns, all, however, under the letter A; in turn *cut-out* is to be found in heavy type in the English column under the letter C, and *interrupteur* in heavy type in the French column under the letter I. The author states that he has adopted this method in order to save space, which it undoubtedly does, and though it appears clumsy, it is quite possible that with practice the system might be found less inconvenient than it is in the hands of one not experienced in it.

On the score of completeness there is not much to be said; most of the ordinary words that are likely to occur in a work dealing with pure chemistry or pure physics are to be found. On the other hand, the far more difficult side, that of the applied sciences, is very imperfectly represented, whereas the names of minerals figure very largely, though these as a rule present very little difficulty.

It is mainly on the matter of accuracy that this dictionary affords ground for complaint, mistakes of all kinds being numerous. A few may be quoted at random: The German for pyrrhotite is given as *Leberkies*, whereas it should be *Magnetkies*; *Leberkies* is the name given to a variety of Marcasite. *Raseneisenerz* is incorrectly translated *limonite*, instead of bog ore. German silver is not the same thing as Constantan. *Abraum* salt is certainly not English, any more than is *Amiant*. A good example of the careless work that disfigures this book is

found in the translation of *balance romaine* as Swedish (sic!) *balance*. It is obvious that this dictionary is anything but a trustworthy guide, and a work that will not stand this essential test cannot safely be recommended to the student.

H. LOUIS.

PUBLICATIONS RECEIVED

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918. No. 7. MANUFACTURE OF NITRIC ACID FROM NITRE AND SULPHURIC ACID. Ministry of Munitions and Department of Scientific and Industrial Research. London: H.M. Stationery Office, 1922. Price 11s.

LABORATORY EXERCISES IN INORGANIC CHEMISTRY. By PROF. J. F. NORRIS and PROF. K. L. MARK. Pp. 548. London: McGraw-Hill Publishing Co., Ltd., 1922. Price 10s.

LABORATORY MANUAL OF COLLOID CHEMISTRY. By PROF. H. N. HOLMES. Pp. 127. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922. Price 10s.

A SYSTEMATIC QUALITATIVE CHEMICAL ANALYSIS. By PROF. G. W. SEARS. Pp. 119. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922. Price 8s. 6d.

CHEMISTRY FOR BEGINNERS AND SCHOOLS. By C. T. KINGZETT. Fourth edition. Pp. 237. London: Baillière, Tindall and Cox, 1922. Price 5s.

FILTRATION. By T. R. WOLLASTON. Pitman's Technical Primers. Pp. 102. London: Sir Isaac Pitman and Sons, Ltd., 1922. Price 2s. 6d.

THE PROPERTIES OF ELECTRICALLY CONDUCTING SYSTEMS. By PROF. C. A. KRAUS. American Chemical Society, Monograph Series. Pp. 415. New York: The Chemical Catalog Co., Inc., 1922. Price \$4.50.

GRUNDZÜGE DER ANGEWANDTEN ELEKTROCHEMIE. VOL. I. ELEKTROCHEMIE DER LÖSUNGEN. By PROF. G. GRUBE. Pp. 268. Dresden and Leipzig: Th. Steinkopff, 1922. Price, paper 8s. 4d., bound 10s. 3d.

QUICKSILVER, 1913—1919. The Mineral Industry of the British Empire and Foreign Countries. War Period. Imperial Mineral Resources Bureau. London: H.M. Stationery Office, 1922. Price 1s.

SOME PROPERTIES OF POWDERS WITH SPECIAL REFERENCE TO GRADING BY ELUTRIATION. Discussion held by the Oil and Colour Chemists' Association and the Faraday Society on March 9 and 23, 1922. Published in the Journal of the Association, Vol. 5, No. 30, March, 1922. Price 2s. 6d.

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PUBLICATIONS OF THE UNITED STATES BUREAU OF MINES. Department of the Interior. Washington: Government Printing Office, 1922:—PREPARATION AND USES OF TAR AND ITS SIMPLE CRUDE DERIVATIVES. By W. W. ODELL. Price 15 cents.

THE ANALYTICAL DISTILLATION OF PETROLEUM AND ITS PRODUCTS. By E. W. DEAN, H. H. HILL, N. A. C. SMITH, and W. A. JACOBS. Price 15 cents.

REVIEW

Vol. XLII]

AUGUST 31, 1922

[No. 16

THE COMPARATIVE SWEETNESS AND PRESERVING QUALITY OF CANE AND BEET SUGARS

JAMES P. OGILVIE

AT the present time various grades of white cane and beet sugar are sold on our market, and broadly these may be divided into (1) refined and (2) direct-consumption sugars. By a refined sugar is generally understood a product which is obtained by re-melting raw cane or beet sugar, passing the resulting liquor through animal charcoal to decolorise and purify it, and finally re-crystallising. Granulated and cube sugars so produced in refineries in this country are of a remarkable degree of purity, and their sucrose content generally reaches 99.95 per cent., the traces of moisture, ash, reducing sugars, and organic non-sugars which may be present being hardly capable of determination even by the application of special methods. (*Intern. Sugar J.*, 1920, 654). It is conceded by all that there can be no difference in the sweetness or preserving quality of such a highly refined product (which is in effect pure sucrose), whether it is derived originally from the cane or the beet.

DESCRIPTION OF DIRECT-CONSUMPTION GRADES

The direct-consumption sugars, as the term suggests, are grades produced directly from the cane or the beet without the intermediary of the refinery, or the use of animal charcoal, of suitable purity for use on the table or for manufacturing purposes. They are made by liming and sulphiting or carbonating the juice, filtering the syrup or allowing it to subside, and washing the resulting crystals with water and steam in the centrifugal machine. The best grades of cane or beet sugar thus made have a sucrose content of about 99.5 per cent., are of good colour, and can very well be used for domestic purposes, though admittedly they do not possess as a rule the faultless appearance of the best refinery product. Excellent direct-consumption cane sugar is now being imported into this country (though as yet in comparatively small amount) from the British West Indies (a recent analysis gave, per cent.:—sucrose, 99.5; reducing sugars, 0.23; ash, 0.02; organic non-sugars, 0.15, and moisture 0.10); whilst as an example of a superior direct-consumption beet sugar may be mentioned the granulated sugar produced at the beet-sugar factories in this country during

the last season (*cf. J.*, 1922, 149-154 R, Kelham sugar giving the following figures: sucrose, 99.9; reducing sugars, absent; ash, 0.01; organic non-sugars, 0.04; and moisture, 0.05 per cent. Cantley sugar is equally pure). Other grades of direct-consumption sugars are used in the United Kingdom in the jam, confectionery, biscuit, and condensed-milk industries, though these are often "off-colour," and therefore not in demand in the grocery trade.

These lower grade direct-consumption sugars have only a slightly smaller sucrose content than the refined article; and the difference between them and pure sucrose is to be attributed to the small amount of impurities, such as reducing sugars, ash, and organic non-sugar matter (the last-named including traces of colouring and aromatic substances), which are occluded in the interstices between the lamellæ of the crystals. Direct-consumption cane sugars generally contain reducing sugars, and may possess a slightly acid reaction, whilst the trace of non-sugar substances which they contain imparts a faintly pleasant flavour derived from the original juice. On the other hand, beet sugars normally do not contain reducing sugars, and in the case of the lower grades their solutions may be slightly alkaline. Further, the inferior grades of white beet sugars, such as the so-called "washed crystals," may still retain a trace of the objectionable (almost nauseous) flavour that is so characteristic of the juice from which they are extracted. Then in this description of direct-consumption grades mention may be made of the palatable and wholesome West Indian yellow crystal sugars, which are manufactured directly from cane juice by a special process of clarification and boiling; that is, of course, the genuine Demerara or Trinidad crystal sugars, and not the yellow crystals made by some houses in this country by incorporating white crystals (sometimes beet) with a syrup containing a suitable organic dye. They consist approximately of 96 per cent. of crystal surrounded by a syrup containing reducing sugars, ash, and organic non-sugars, including the bodies imparting the very pleasant taste and aroma of the cane juice. The precise nature of these flavouring substances remains undetermined.

COMPARATIVE SWEETNESS OF CANE AND BEET SUGARS

The opinion appears to be quite widely held, and in fact is often definitely expressed, not only by the general public and by sugar salesmen, but also by physiologists who have considered the matter, that the various grades of sugar on the market do actually differ in sweetness, in spite of the fact that their sucrose content may be about the same. Even in Germany there are many who admit that "colonial sugars" (i.e., cane products) are sweeter than the lowest grade granulated beet sugar sold there, or even than the char-refined beet product. It seems, therefore, of some interest to examine the question, and to state the known facts which may account for such an opinion.

Preliminarily, it may be pointed out that a correct judgment can hardly result from tasting the crystals themselves, since their size and hardness considerably influence the sweetening effect thus obtained. It is evident that a fine and soft-grained sugar will pass more quickly into solution in the mouth than a product consisting of hard and large crystals. Obviously, therefore, tasting experiments must be performed with solutions of the various samples, using preferably a saporimeter, such as that designed by Kremer (*Nederl. Tijdschrift voor Geneeskunde*, 1917, No. 3, 149-157), whilst also following a suitable method for diluting the sapid substance with water, and a definite procedure for eliciting the decision of the individual tasters, such as that described by Toulouse and Vashide (*Comptes rendus*, 1900, 130, 803; 1904, 139, 898).

The reader may be reminded that on the surface of the tongue and soft palate are numerous papillæ, of which many bear at the base or on the top the so-called "taste buds," structures which are the terminations of the gustatory nerve fibres. These nerve endings are capable on excitation of giving rise to gustatory sensations, which are broadly classified as sweet, acid, bitter, and salt. Each of these sensations is believed by many physiologists to be registered by a specific set of nerves; in other words, the particular nerve endings producing the sensation of sweetness appear to be incapable of excitation by an acid, a bitter, or a saline substance.

An important fact here to bear in mind is that there appears to be reliable evidence for the statement that the intensity of a gustatory sensation (sweetness, for example) may be modified when another set of nerves in the vicinity (say, those producing an acid taste) is at the same time excited (*Zeitsch. f. Psychologie u. Physiologie der Sinnesorgane*, 1899, Bd. 21).

INFLUENCE OF TRACES OF ACID AND ALKALI ON SWEETNESS

Thus, it will be found that if two solutions be prepared, the first containing 15 and the

second 12 per cent. of sucrose, and if to the latter a trace of acid be added, it is possible by gradually increasing this addition to arrive at a certain concentration of the mineral or vegetable acid at which most of the tasters would consider the weaker solution of sucrose to be the sweeter (*Archives Néer. Physiol.*, 1917, 1, 625). A similar result has been obtained by adding quinine hydrochloride and other bitter substances (Du Bois Raymond's *Archiv f. Physiologie*, 1892). It has been established that if two solutions be made up both containing, say, 15 per cent. of sucrose, and if to one of them about 0.1 per cent. of sodium chloride be added, nine persons out of ten tasting the two liquids would declare the solution containing the small amount of salt to be appreciably the sweeter (*Archives Néer. Physiol.*, 1917, 1, 625). It is, of course, well understood that if the amount of any one of these additions is increased beyond a certain point, the acid, the bitter, or the saline taste will become apparent, and the solution of sucrose will then certainly become less sweet. On the other hand, it has been proved that traces of alkali depress the sweetening effect of a solution of sugar, and a well-known German chemist once stated (*Vereinszeitschrift*, 1892, 42, 580): "According to my experience, the sweetness of sugar is greater when traces of acids, especially fruit acids, are present than in solutions which, as in the case of our beet sugars, contain a trace of alkali."

INFLUENCE OF ODORIFEROUS AND OTHER FOREIGN SUBSTANCES

Further, the sense of taste is certainly affected by odoriferous substances. In an authoritative textbook ("A Textbook of Physiology." By Sir Michael Foster, in Part IV. The Senses. Page 1513) the statement is made that if the nose be held, and the eyes shut, it is very difficult in eating to distinguish between an apple, an onion, and a potato, the three being recognised when their respective aromas are eliminated only by their texture in the mouth, and not by their "taste." W. H. Th. Harloff remarked (*Intern. Sugar J.*, 1920, 105) that when palm sugar (which is exceedingly luscious) is dissolved in water and treated with a decolorising carbon for the absorption of its non-sugars, one obtains a liquid that is much less sweet than the original solution, although its content in sucrose and reducing sugars may be the same. A similar observation was made by F. I. Seard (*ibid.*, 1904, 478) to the effect that the pure sucrose obtained by washing Demerara sugar to remove the adhering syrup, and recrystallising the white sugar left appeared almost tasteless in comparison with the original crystals.

These several points regarding the factors capable of influencing the sweetness of a sugar seem to be well established; and in fact are so well recognised that the proposal has been made to add traces of vegetable acids and flavouring

substances to pure white sugar for the purpose of increasing its sweetness and palatability as a commercial article.

Summarising the conclusions to be drawn from the observations cited above, it may be said that there appears to be good evidence for the opinion that some grades of white sugars, namely, those containing traces of acid and flavouring substances, may be sweeter than others, when tasted in solution. Thus, by way of example, if one were to examine in the manner already indicated four different grades of sugars, viz., (1) the best refined; (2) a low grade cane direct consumption; (3) Demerara yellow crystals; and (4) an inferior beet direct consumption, there seems little doubt that in the opinion of the tasters the Demerara yellow crystals would be considered somewhat sweeter, weight for weight, than the refined article, in spite of there being a difference of about 4 per cent. in the sucrose content of the two sugars. Further, it seems certain that the direct-consumption cane sugar would be adjudged slightly sweeter than the refined, though less sweet than the Demerara product; whilst the least sweet of the four would probably be the inferior beet, especially if this were of the washed crystal type containing a small amount of alkali carbonates, such as was imported into this country from Germany and Austria previous to the war.

PRESERVING QUALITY OF CANE AND BEET SUGARS

The preserving quality of a sugar, whether derived from the cane or from the beet, depends upon several factors, two of the principal of which are: (1) its freedom from micro-organisms capable of inducing fermentation; and (2) its reaction, which should be neutral, or slightly acid. It should also be free from any flavouring or colouring matter which may adversely affect the taste or appearance of the preserve.

In regard to the first factor, namely, freedom from septic micro-organisms, it was formerly claimed that refined sugars only should be used for preserve-making on the ground that it was only by the use of animal charcoal that a sterile product could be obtained. However, direct-consumption sugars made from both cane and beet are in use at the present time in the jam, fruit-canning, and condensed-milk industries with results as satisfactory as those obtained with the refined grades.

It is now known that in the manufacture of direct-consumption sugar, whether by sulphitation in the cane-sugar house, or by carbonatation in the beet factory, a practically sterile juice results after allowing the precipitate of calcium sulphite or carbonate to subside or filtering off. (*Intern. Sugar J.*, 1919, 465). Subsequently, both in refining and in manufacturing direct-consumption sugar, some re-infection occurs when the crystals are exposed to the air in the

centrifugals, due no doubt to the large volume of air which is sucked against the mass during its very rapid revolution; but later if the sugar be treated with steam while still in the machines practically all the bacteria and moulds are destroyed (*Intern. Sugar J.*, 1920, 591). The importance of the sterilisation of sugars in this way, and of their packing, storage, and transit under cleanly conditions, is now recognised by manufacturers of high-grade direct-consumption sugars.

Coming to the second factor mentioned above, namely the reaction of the sugar, it is of course well recognised that in jam and jelly manufacture the fruit juice must have a certain acidity, otherwise the pectin will not jell. Investigation of the reason why in preserve-making a syrup instead of a jelly may result has sometimes indicated, when a low-grade beet sugar has been employed, the presence of alkali carbonates in sufficient amount to lower the acidity of the fruit juice below the optimum for the setting of the pectin. However, this condition is hardly likely to be encountered at the present time, though it may well serve as some explanation of the origin of the popular prejudice which persists against the use of beet sugar for the purpose. Most of the white grades of cane and beet sugars now on our market are of high purity; and the British beet sugars have been shown to give entirely satisfactory results in the jam, condensed-fruit and other industries in which sugar may be used. In jam and jelly manufacture it would seem that in the event of trouble the sugar used is usually the factor for suspicion; whereas the actual reason for the refusal of the fruit juice to jell is more likely to be connected with other causes, such, for example, as the low acidity of the fruit juice, an insufficient pectin content, the hydrolysis of the pectin by prolonged boiling, or the use of too high a proportion of syrup.

CANE SUGAR V. BEET SUGAR

The death-blow to the notion that for some peculiar reason or other sugar which is derived from the beet is unsuitable for use in the preparation of jam or jelly and fruit preserving was given by G. W. Shaw, of the Experiment Station of the University of California, in a series of comparative tests (*Intern. Sugar J.*, 1919, 619). The cane sugar was a product originating from the Western Sugar Refinery, San Francisco, and had a sucrose content of 99.7; whereas the beet sugar was a white granulated product made directly from the root by the American Beet Sugar Co., of Oxnard, Cal., and polarised 99.8 per cent. A large number of fruit-preserving tests (about 2000) showed that the two sugars gave identical results, and that in both series the product was as clear as it was possible to be. Not the slightest difficulty was experienced in the preservation in either case.

EMULSIONS IN TECHNICAL PRACTICE

THE study of the physico-chemical basis of emulsions, and of the colloidal and surface-tension phenomena they exhibit, has advanced technical practice in the formation and breaking of emulsions to a considerable degree, and empirical experimentation has helped to solve many problems in this field by accumulating data for subsequent scientific investigation.

Processes for the formation of stable emulsions on the one hand, and the resolution of undesirable emulsions on the other, are of general interest to chemical technologists. Thus, every year in this country tens of thousands of tons of "soap stock" are produced in the refining of vegetable oils, and as much as 80 to 90 per cent. of the neutral-oil content can be recovered, instead of being sold at a relatively low figure in the "stock" for soap-making or in the "black greaso" obtained on acidification.

The dehydration of tars involves the separation of emulsions, and it is well known that many water-gas tars cannot be dehydrated by settling, even at raised temperatures and after long periods of treatment. The slow process of settling raw linseed oil, to obtain oils free from water and mucilaginous matter for use in the paint and varnish industry, can be hastened considerably by applying the principles of emulsion breaking. A final instance, though not of direct interest to this country, is of world importance, viz., the separation of petroleum emulsions. Comparatively recently millions of gallons of mineral oil were wasted annually owing to the impracticability of removing the water from the oil emulsions found in many oilfields.

The value to the manufacturers of "solid" and colloidal lubricants and to the textile industry of scientific data regarding emulsion formation and stabilisation to the margarine industry cannot be overestimated.

EMULSIONS

To form a stable emulsion of two immiscible liquids, a third component is necessary, which may consist of an emulsoid. According as one or other component becomes the disperse phase (*e.g.*, in emulsions of oils and water) a hydrophilous or a hydrophobous colloid has to be found. Soap, gum arabic, starch, gelatin, etc. may serve as emulsoids, and a film is formed at the interface between the two components.

Finely-divided solids may also help to produce permanent emulsions. Thus, Pickering demonstrated that oil-water emulsions could be produced by means of finely-divided solids, provided that the solid was more easily wetted by the water than by the oil; in this case the water becomes the disperse phase and the

oil particles of the continuous phase are coated with a stable film of finely-divided solid. Later it was shown that water-in-oil emulsions could be formed by means of carbon black and similar substances, more easily wetted by the oil than by the water. Thus, a stable emulsion of water in kerosene can be prepared by means of carbon black, the black separating at the oil-water interface. Emulsions produced by means of finely-divided solids resemble in most respects those formed with the aid of a soluble emulsifier—a hydrophilous or hydrophobous colloid.

The extensive subject of emulsion formation and stability cannot be discussed here, it must suffice to state that the above two methods of formation are of especial interest in considering such problems as those presented by oilfield emulsions, soapstock separation, tar-dehydration, etc. The breaking or resolution of emulsions involves consideration of the relation between stability and size of particles, of viscosity of the respective components, and relative specific gravity. In this place only the practical methods evolved for disturbing the equilibrium of the emulsion system will be considered.

SEPARATION OF EMULSIONS

Much of the work done on the separation of emulsions on a technical scale has been inspired by the wastage of valuable mineral oil in the oilfield emulsions (*cf.* J. Ind. Eng. Chem., Nov., 1921), but many of the developments are applicable to other types of emulsions, with little or no modification.

It may be of interest first to record methods as yet unused in practice, and depending upon the differential wetting of filtering media. The use of kieselguhr has been advocated, the underlying principle being that during filtration this substance should "cut" and destroy the protective film surrounding the water particles in an oilfield emulsion (water in oil) and so allow of rapid coalescence and subsidence of the water by gravity.

GRAVITY

The first attempts to deal with oilfield emulsions were based upon subsidence, but the impossibility of treating many types even after very long periods of settling at ordinary temperature, led to settling in pools exposed to the heat of the sun. The reduction of viscosity consequent upon raised temperature allowed of separation to some extent and in certain cases, but was only feasible when low-boiling fractions of the crude oil commanded no market value. Continuous settling in closed tanks suitably heated, naturally followed upon the introduction of the internal-combustion engine. Heating of the oil cannot, in many cases, be

effected by direct heat from steam-pipes or jackets, as the water particles near the steam-pipe volatilise and then condense in extremely finely-divided particles in the cooler parts of the oil emulsion, which becomes more stable. In such a case the emulsion should be floated upon water into which steam is blown. Convection currents are set up and the emulsion is heated without vaporising the water; in this manner coalescence and subsidence by gravity are hastened.

Such methods are, however, cumbersome in application, and are not in general use. Mention, however, should be made of the increased difference in specific gravity produced by adding an oil solvent, such as petroleum ether. The reduction of viscosity and specific gravity of the non-water part of the mixture allows more ready separation of the water component, but the method is seldom adopted in practice. The following suggestion may, however, be noted. The emulsification of certain oils of asphaltic base is said to be due to earthy matter coated with asphalt, a mixture which, being an oil-soluble colloid stabilises the water-in-oil emulsion. On adding a solvent the asphalt dissolves and leaves the finely-divided earthy matter, which is not an oil-soluble colloid, so that the emulsion becomes more easily resolvable. The effects of reduced viscosity and greater differences in density must, however, be of moment in the final separation of the components.

ADDITION OF REVERSE EMULSOID

If an emulsion is stabilised by a hydrophobous colloid, as in water-in-oil emulsions, the stability of the whole can be decreased by the regulated addition of a reverse colloid, a hydrophile, and breaking by settlement often results in relatively short time. Separation can often be caused by carefully adding a water-soluble soap and ensuring contact with the water globules in the emulsion. Such a hydrophilous colloid, however, will *stabilise* an oil-in-water emulsion, and it is therefore necessary to add a colloid which will easily make contact with the dispersed water in the water-in-oil emulsion. Such hydrophilous colloids are represented by a mixture of sodium oleate and oleic acid, sodium resinate and free resin, etc., the mixture being able to make contact with the dispersed water globules through the oil.

It is probably impossible to separate all types of oil-field emulsions by the use of one particular reverse colloid, and each emulsion should be regarded as a separate problem. Nevertheless, use of the compound known as "Tret-O-Lite" has met with considerable general success in recovering oil from emulsions that were formerly wasted. The compound consists of sodium oleate 83%, sodium resinate 5.5%, sodium silicate 5%, phenol 4%, paraffin 1.5% and water 1%. More recently the use of com-

pounds containing sodium salts of sulphonated oils has been suggested.

ELECTRICAL METHODS

It has been suggested that the addition of electrolytes to an oil-field emulsion will cause separation of the water particles, negatively charged; in particular, acids and ferric salts have been recommended, but they have not come into general use.

The coalescence and subsequent subsidence of the water globules has, however, been successfully accomplished by using a high-potential electrical field. The action, which was suggested by the successful methods of precipitating dust, is stated to depend upon the electrical charge borne by the water globules; the enveloping oil-film is ruptured, the water particles coalesce more readily, and separation by subsidence follows.

The apparatus that has found favour in many districts consists of a tank, 3 ft. in diameter and 8 ft. high, containing a centrally disposed revolving electrode. The electrode shaft carries a number of circular discs and is supported by an insulated bearing. The tank itself, being earthed, serves as the second electrode. The oil is fed continuously into the annular space between the tank and the central electrode, and a potential difference of about 10,000 volts is maintained between the tank and central shaft. The treatment of the oil-emulsion can be carried out at raised temperatures, say, 135° F., the maximum temperature advised being 180° F. To avoid loss of the valuable lower-boiling fractions, the treatment is carried out in closed systems and under pressure. After passing through the electrical field, the mixture is led to a trap settling-tank, where the oil and water are finally separated by subsidence.

The capacity of such an electrical system varies from 300-1000 barrels per 24 hours, and naturally the power consumption also varies. From 5-75 watt-hours may be required per barrel of oil treated, but the cost does not average above one cent per 20-50 barrels. The over-all cost, including steam, power, labour, repairs, interest, depreciation, and royalties ranges between 1 and 3 cents per barrel of oil recovered.

It is claimed that this system is universally applicable, and that it can be successfully used for such stubborn emulsions as "Tank bottoms." The system has been chiefly used in California.

The claim advanced by advocates of electrical treatment, that all emulsions can be economically treated in the above manner, is challenged in some quarters, but there is no doubt that similar methods are useful for breaking several different types of emulsions. The coagulation of finely-divided particles in suspension in oils by applying electrical force so that a rapid continuous settling process becomes possible, is a case in point.

CENTRIFUGAL SEPARATION

The increased rate at which emulsions can be separated by applying centrifugal force has been much advocated by the makers of the Sharples "Super-Centrifuge," which is capable of developing a speed of 18,000 revolutions per minute in large-scale apparatus. The emulsion can be treated at a raised temperature, as the loss of valuable light fractions is negligible on account of the speed at which separation is effected. The main factors of coalescence and subsidence are altered only in respect of time of operation, and the speed at which the oil and water are separated may be increased still further by the aid of reverse colloids.

Thus, the addition of starch in an oil-soluble state caused a certain oil emulsion to separate at the rate of 5 barrels per hour, and when 0.001 per cent. of oil-soluble sodium soap, starch, or glue was added to the emulsion several hours before centrifuging the rate of separation was 15 barrels per hour. Slightly larger amounts of hydrophilous emulsoid are required if centrifugal force is applied nearer to the time of addition.

On the ground that the hydrophobous emulsoid is present in all oil-field emulsions in approximately the same small amount, it is claimed that the above treatment, or a slight modification of it, is applicable to all forms of such emulsions. Much success has certainly been achieved by the use of the "Super-Centrifuge," but whether it is the alpha and omega of oil-field emulsion problems is still disputed.

The cost of treatment by centrifugal force has been placed at 7 cents per barrel, which compares unfavourably with the electrical method, provided emulsions are equally capable of treatment by the two methods. The Super-Centrifuge has, however, proved its great value in separating soap stock, an emulsion produced in large quantities in refining vegetable oils, and until recently sold without separation of its content of valuable neutral oil.

SOAP-STOCK SEPARATION

Of the methods of emulsion-breaking mentioned, the application of the Super-Centrifuge is the only one that has been worked successfully. As much as 80-95 per cent. of the neutral-oil content of soap stock has been recovered regularly in the form of an easily refined oil, which is much more valuable than as a component of original soap stock or of the "black grease" obtained from it.

The soap stock is treated in two distinct stages. In the first, the stability of the emulsion is decreased by diluting with 0.5-2.0 volumes of water, and heating to 100° C., 2 per cent. of sodium carbonate also being added. Other salts, or a weak acid such as boric acid, may be employed, but salting out of the soap and decomposition of either neutral oil or soap should be avoided. The diluted soap stock is

then allowed to settle, and the lower layer of aqueous soap solution is withdrawn.

The second stage consists in the centrifugal treatment of the destabilised emulsion, whereby two products are obtained, the one consisting of neutral oil containing very small quantities of soap solution, and the other of soap solution with little oil. The neutral oil is treated with salt to separate the small quantity of soap, and is then ready for final refining to an edible product.

The value of the process can be judged by the fact that from 80-95 per cent. of the neutral oil can be recovered, say, from an oil-content totalling 25 per cent., and this oil is approximately three times more valuable than that present in soap stock.

The constructional details of the Super-Centrifuge need be indicated but briefly, full descriptions being available elsewhere. The machine consists of a small, high-speed elongated or tubular bowl capable of revolving at 18,000 revolutions per minute. The bowl, 4-5 in. in diameter, is supported and driven from above, and there is only one set of ball bearings. There is little wear and tear, and the machine runs very smoothly, except perhaps whilst attaining its full speed. An extension from the bowl, however, runs in a socket and guides the rotating bowl during this period. Afterwards the bowl is free to find its own axis.

CORRESPONDENCE

THE CHEMIST AND THE MANUFACTURER

Sir,—The contribution of Mr. A. A. Drummond to an old-time controversy suggests a treatment of the problem by the psychological method of Oliver W. Holmes.

The Manufacturer, M, represents three personalities, M', M'', M''': the Chemist similarly.

M'—C' are the actual men.

M''—C'' the ideals of M'—C', each of each.

M'''—C''' the respective reciprocal ideals.

Consequently, in any and every contact, the number of psychological equations to be satisfied is not less than 3×3, a complication which partly explains. "Plus ça change, plus c'est la même chose," and, freely translated, "mained shows." —I am, Sir, etc.,

C. F. Cross.

Lincoln's Inn, London.

August 8.

Sir,—In your issue of August 15 a letter under this heading raises the interesting and important question of what the colleges are doing for industry.

One may presume that a large number of the chemical students in our colleges and universities are anxious in due course to obtain situations in British chemical factories. Apparently some of those responsible for their training consider it necessary to provide those embryo factory chemists with a complete supply of German chemicals for their laboratory work.

In spite of all the lessons of the war, in spite of the tremendous efforts which have been made to render our teaching institutions independent of German laboratory chemicals there are again, I regret to say, cases, which one could name, of prominent universities obtaining the bulk of their supplies from German sources. These universities are supported by grants of public money—the money of the British taxpayer. I know that these institutions will reply that they can buy these foreign chemicals so much more cheaply. Perhaps they can for the moment, but one wonders whether in the long run it is cheap to teach our young chemists the use of foreign chemicals, and thus help to stifle a section of that very chemical industry to which many of them are looking for future employment. With your correspondent I would say to the universities: "Broaden your outlook; teach patriotism toward your industry." Who but madmen would train students for occupations in any industry which they are helping to kill? Yet is not this the position of those who unnecessarily fill their laboratories with German chemicals for education and research purposes?

The colleges *can* do something for British chemical industry. They can, and should, endeavour to support it.—I am, Sir, etc.,

A FINE CHEMICAL MANUFACTURER.

London, August 23.

NEWS AND NOTES

UNITED STATES

Autumn Meeting of the American Chemical Society

The meeting to be held in Pittsburgh from September 4 to 8 will probably be attended by 1500—2000 chemists. The chief address will be delivered by Dr. E. E. Slosson, author of "Creative Chemistry" and now editor of *Science Service*, Washington, on "The Constructive Chemist"; and the papers to be read include one by Mr. F. G. Breyer on a new form of zinc oxide consisting of smaller particles than any existing form, and which is claimed to double the life of the tread of an automobile tyre. Dr. T. Midgley, jr., and Mr. T. A. Boyd will demonstrate the detonation of various motor fuels and explain how "knocking" of the engine may be reduced.

Following the meeting (September 11—16), the Eighth National Exposition of Chemical Industries will be held in the Grand Central Palace, New York, where the exhibits will be confined to products of American firms. About 450 American manufacturers are expected to participate, and an interesting feature will be the provision of kinematograph pictures and lectures on subjects relating to various branches of the industry. Two special sections, on fuel economy and on containers, have been added to this year's exhibition.

Pulverised Coal and Explosion Risks

The precautions which should be taken to minimise the risk of explosions when pulverised coal is used in industrial plants have been investigated by the Bureau of Mines and form the subject of a paper by Mr. L. D. Tracy. It is most important to prevent any accumulation of dust exposed to the

air in any part of the plant as this is always liable to form an explosive cloud on being disturbed; a mixture of 0.032 oz. of coal dust with one cu. ft. of air has been found sufficient to cause an explosion when brought in contact with a flame. It is often assumed that sufficient inert matter becomes associated with the dust near furnaces to render it non-explosive, but this is not always the case. The proportion of inert matter which must be present with the coal dust to render it harmless is correlated with the ratio of volatile matter to total combustible matter in the coal. A dust containing over 30 per cent. of ash and only 11 per cent. of volatile matter was found to form an explosive mixture.

In France and Germany vacuum cleaning plants have been installed in connexion with coal-crushing plants in order to facilitate the removal of dust from all parts of the buildings and machinery. Much may be done to prevent the accumulation of dust deposits by maintaining plant in an efficient state, and the risks resulting from any accidental escape of dust may be minimised by consideration of the general lay-out. The drier should be in an isolated position and storage-hoppers should be isolated from boilers or furnaces. Particular attention is directed to all electrical equipment and to the possibility of an electrical discharge from any rapidly moving machinery. Spontaneous combustion of the dried coal is a frequent source of serious trouble. It is questionable whether greater efficiency is attained by working the drier at a higher stack temperature than 150° F., but in any case coal at a higher temperature should not be kept in storage. When the system of circulating pulverised coal is used there is always a risk of fires travelling back from the furnaces. This may be minimised by maintaining the pressure at all points of the distribution system higher than that of the secondary air supplied to the furnaces. A suitable vent should be provided near the outlet of the fan so that in the event of an explosion within the distribution-main the fan will not be damaged.—(*Proc. Eng. Soc. of W. Pennsylvania*, June, 1921.)

Lime in 1920

Although the sales of lime in the United States in 1920 increased in quantity by 7.2 per cent. to 3,570,141 short tons and in value by 27.5 per cent. to \$37,543,840, the demand was greater than the supply. This shortage was due entirely to lack of skilled labour and to transport deficiencies, as many of the plants did not operate at full capacity. In all 1,000,550 t. of "chemical lime" was sold, 316,293 t. being used in making refractories, 104,250 t. for alkalis, 90,533 for purifying water, 88,465 t. for calcium carbide, 48,361 t. for acids and 21,845 t. for soap, oils and fats. The chemical industry also consumed the following quantities of lime and of hydrated lime, respectively:—Paper 365,897 t., 7237 t.; glass 54,747 t., 3232 t.; sugar 14,145 t., 4111 t.; tanneries 61,162 t., 14,828 t.; metallurgy 344,921 t., 1521 t. Of the 853,116 t. of hydrated lime sold, 116,748 t. was used in chemical industry. Sales of marl amounted to 97,487 t., mostly for use as an agricultural dressing and partly as a filler for fertilisers, and 38,506 t. of oyster-shell lime was sold for use on the land. Imports (mainly from Canada) and exports were small, amounting to 22,638 t. and 5921 t., respectively (*cf. J.*, 1922, 175 R).—(*U.S. Geol. Surv.*, Nov. 3, 1921.)

Production and Consumption of Sugar in 1921

According to figures published by the U.S. Department of Agriculture, the production of sugar in the United States in 1921 was as follows:—Beet sugar 1,012,382 short tons; cane sugar 270,270 t.; maple sugar 2547 t.; or a total of 1,285,199 t., compared with 1,269,913 t. in the previous year. The actual consumption of sugar in 1921 is given as 5,274,225 t., or 28.4 per cent. of the world's production and an increase of 25.9 per cent. over the average for the 10-year period ending 1920. The *per capita* consumption in 1920 was 97.8 lb., the largest amount recorded. About 1,066,463 t. of sugar was supplied by non-contiguous territories of the United States (Hawaii 488,869 t., Porto Rico 409,022 t., Philippines 168,572 t.) and 3,336,521 t. from foreign countries. Exports amounted to 394,632 t., a small increase compared with the average of the previous ten years. (*U.S. Com. Rep.*, Mar. 6, 1922; *Ind. Tr. J.*, May 18, 1922.)

Sugar Industry in the Philippines

Owing to the prosperity of the sugar industry in the Philippine Islands during 1919 and 1920, the Philippine National Bank and other corporations have built sugar centrals that bring the total up to 32. These centrals are scattered through central Luzon, the Manila district, and Negros, the chief cane-producing areas, and have an annual productive capacity of 320,000 tons of 96° sugar. The planters believe that it will pay to build more centrals and to cease marketing muscovado sugar in quantity. In Cotabato, province of Lanao, the area of suitable land is greater than that now under cane in Cuba, and the island of Negros already produces 60 per cent. of the cane crop of the Philippines. The prospects of building up a very important sugar industry are excellent.—(*Ch. of Comm. J.*, Apr. 14, 1922.)

CANADA

Mining

Free gold bearing ore has been found on the property of the Gold Nugget Mining Co. at Ess Lake, Northern Ontario.

It is stated that some valuable mica properties, near Ottawa, Quebec, have been purchased by the Westinghouse Electric Co. of America.

South African mining interests have made an offer for the Teck-Hughes and the Orr Gold Mines, in the Kirkland Lake district of Northern Ontario.

The Nichols Copper Co., New York, has obtained the contract for selling the copper output of the Granby Consolidated Mining Co., which averages about 3,000,000 lb. a month, and is shipped from Anox, B.C., to Laurel Hill, near New York, for refining.

The new cyanide plant of the Pioneer mine in Lillovet district, B.C., is ready for operation. There is a possibility of the Consolidated Mining and Smelting Co., Ltd. taking over the smelter at Ladysmith, Vancouver Island. If so, it would treat the gold, copper, silver and lead ores available from coast mines and drawn from the Omineca, Skeena, Naas River, Portland Canal and other mining districts. These ores now go to the Tacoma (Wash.) smelter or to the Selby smelter at San Francisco.

The Consolidated Mining and Smelting Co. is installing a copper rod mill at Trail, B.C., at a cost of about \$250,000. It is expected that this will lead

to the development of copper wire drawing in Canada.

Considerable activity is being shown in staking mining claims in the district east of Matheson, Northern Ontario. The Blue Quartz property near Painkiller Lake, has been bagging some good ore from the 100 ft. level. The vein is about two ft. wide and assays show the gold content to be from \$44 to \$166 per ton.

Petroleum

The Canadian Western Natural Gas Co. is boring, with a rotary drill of 17½ in. diameter at Barnwell, Alta., to a depth of 2,600 ft.

Another syndicate, known as the White River Oil Co. is putting down test holes for petroleum in the Hay River country. The Hay river flows from Hay Lake north-easterly into Great Slave Lake, and the boring will be done at a point 13 miles up the river.

An oil boom has begun at Medicine Hat, Alberta, a city which is the centre of one of the world's largest gas fields. Since the discovery of gas about ten years ago, the borers have been satisfied to stop operations at the second gas level of 1700 feet. It is now believed that beneath the city and district is an immense lake of petroleum and the fever to bore for oil has developed. The Medicine Hat Development Co. has struck a heavy flow of wet gas at 1700 ft. which is reported to yield 2—3 galls. of gasoline per 1000 ft. This well is about 40 miles from Medicine Hat and, whereas the local gas is odourless, that from the new well has a pronounced odour. Five drilling rigs are in operation boring for oil in this district. Oil has been found in paying quantity in the northern part of Montana, just across the international boundary, in the Sweet Grass district (60 to 70 miles south of Medicine Hat). Boring has been started in the same territory on the Canadian side of the line, and rigs are being put up to drill for oil. The Imperial Oil Co. has purchased the oil lease on a farm ten miles east of Coutts, which joins the boundary, and faces a large block of land leased by two companies on the Montana side.

Pulp and Paper Industry

The Bathurst Lumber and Pulp Co., Bathurst, B.C., proposes to build a paper mill for newsprint. The new mill will give employment to 500 men.

The Westminster Paper Co., a corporation newly organised by capitalists from Peshtigo, Wisconsin, is erecting a paper mill at New Westminster, B.C. The company will specialise in the manufacture of tissue paper for home consumption and export.

Hollingsworth, Whitney, Ltd., of Boston, Mass., has purchased the timber areas and properties of C. T. White and Sons, Ltd., New Brunswick, and Davison Lumber Co., Ltd., Nova Scotia.

The timber areas of the White Co. in New Brunswick aggregate nearly 50,000 acres, including 83 sq. miles of Crown lands under license. The price paid for the properties is stated to exceed \$2,000,000. It is proposed to erect pulp mills in New Brunswick and Nova Scotia.

A survey of the forests of Canada shows that, during the past 55 years, one-half to two-thirds of the forest area of Canada, or approximately one million square miles, has been destroyed by forest fires, and some of this territory has been devastated by fire as many as six times within half a century.

SOUTH AFRICA

Proposed Iron Works at Bloemfontein

It is announced that the Carron Co., of Falkirk, has applied to the Bloemfontein Municipality for 10 acres of ground on the Industrial Development Sites, for the purpose of establishing an iron foundry. The company proposes to spend £20,000 on buildings, and to import twelve skilled men from Scotland. Local unskilled labour will be used, made up equally of Europeans and natives.—(*S. Afr. J. Ind.*, June, 1922.)

AUSTRALIA

Water Power in North Queensland

We have received a communication from Mr. J. Hastings Reed, who states that within 12 miles of the Port of Cairns, North Queensland, there exists an almost unlimited supply of water with a fall of 900 feet. It is proposed to instal a hydro-electric station, and excellent sites with cheap power will be available for electrochemical and similar factories. Local minerals include copper, lead, silver, gold, zinc, antimony, tungsten, molybdenum, manganese, iron, etc. Coal, coke, pure carbonate of lime, alumina, pure white siliceous sand and phosphate rock are available in large quantities. The port is served by the line of steamers plying between Australia and New Zealand, Japan, China, India, and the Straits Settlements.

NEW ZEALAND

Manufacture of Pig Iron in New Zealand

It is announced that the new blast furnace at Onakaka was first tapped on April 27. The furnace was erected by the Onakaka Iron and Steel Co., Ltd., formed for developing part of the large deposits of iron ore at Golden Bay. A modern plant has been installed and the company owns supplies of coal, iron ore, and limestone in favourable situations, but production at capacity will not be initiated until the coking ovens and transport arrangements have been completed. The cost of raw material per ton of iron at the furnace, including royalty, labour and freight, is stated to be: iron ore 12s., limestone 3s., coke 40s.—55s. Labour does not cost more than 15s., and it is estimated that coal from the company's mine, when opened up, will not cost more than 15s. at the works. The output will probably be 24 to 30 tons of pig iron per 24 hours.—(*Bd. of Trade J.*, July 13, 1922.)

BRITISH INDIA

Industrial Notes

Bengal.—Dr. R. Lal Datta, who was recently appointed Industrial Chemist, has begun to investigate problems relating to the manufacture of shellac, the comparative efficiency of salt-raising on the sea-coasts of Bengal, Orissa, Madras and Bombay, the chemical composition of matches, the deodorisation of fish oil for making soap, the preparation of chemically-pure lime for industrial use from the shell-lime deposits of Bengal, the economic possibility of sugar-making as a home industry in Bengal, and of yarn-dyeing as a home industry. Schemes submitted to the Government include one for developing the glass and allied industries of Bengal and another for manufacturing dynamite glycerin under Government patronage.

Bombay.—A sample ton of improved casein will probably be sent shortly to the United Kingdom to ascertain the increased price commanded by material of better quality. Dr. Meldrum is investigating the preparation of rennet casein, the type required by makers of galalith; all Indian casein is lactic and has, therefore, been rejected for galalith manufacture.

The Geological Survey has made suggestions for improving the working of the alkali deposits of Sind, and a chemist will probably be detached to carry out check analyses on the spot.

The research work in Bombay on the discoloration of local magnesium chloride has not given satisfactory results, but the inquiry on the same subject at the Indian Institute of Science, Bangalore, offers more promise. The royalty payable by the Pioneer Magnesias Co. to the Government has now been fixed.—(*J. Ind. Indust.*, May, 1922.)

Oil and Tallow in the United Provinces

The Industrial Chemist reports that the price obtainable for refined tallow is insufficient to pay the cost of refining on modern lines, as the price paid by textile workers for tallow refined by crude, native methods leaves very little margin of profit. Dr. E. R. Watson, of the Technological Institute, is investigating the possibility of using Indian vegetable oils to a greater extent in manufacturing lubricating oils for internal-combustion engines.—(*J. Ind. Indust.*, May, 1922.)

New Sulphuric-Acid Factory in Bombay

The Dharamsi Moraji Chemical Co. has built a sulphuric-acid plant with a capacity of 7500 tons per annum which is the largest plant of its kind in India. It is reported that superphosphate will also be manufactured in the factory, which is one of the first to be built in the Ambernath area (on the G.I.P. Railway) now being developed in Bombay.—(*Chem. and Met. Eng.*, July 19, 1922.)

GENERAL

Liverpool Section

The Liverpool Section of the Society is taking part in the organisation of an Associated Scientific Soirée to be held in the Liverpool Public Museum on Saturday, November 4. Space will be reserved for exhibits from members of the participating societies, and it is suggested that members of the Society of Chemical Industry in the district who would care to show specimens of materials or apparatus likely to be of interest, should communicate as soon as possible with the local secretary.

Platinum and Allied Metals, 1913—1919

A concise account of the properties, uses, prices and production of platinum and allied metals is given in this publication of the Imperial Mineral Resources Bureau (pp. 84, price 2s.). The world's output of platinum up to the present is estimated at about 11 million oz. troy, of which Russia has contributed about 90 per cent., Colombia 7 per cent., and Borneo 2 per cent., the remainder being furnished by the United States, Australia, and Canada. Probably 99 per cent. of this output has been derived from placers, but increasing amounts are being recovered at electrolytic-copper and bullion refineries. During the war period the output of platinum metals from placers declined from 175,181 oz. in 1913 to 73,435 oz. in 1920, but

the fall in the Russian output from 157,735 oz. to 35,000 oz. was partly offset by an increase in that of Colombia from 15,000 to 35,000 oz. (crude). The geological features in certain areas of South Africa (Rhodesia and Cape Province) and of Spain suggest that platinum may eventually be won in payable quantities in these countries. Prices of platinum fluctuated greatly during the war, rising from 185s. per oz. early in 1914 to 220s. in September, 1916, 400s. in March, 1918, and 770s. in January, 1920, but falling to 390s. per oz. at the end of 1921. Platinum came into greater use as a catalyst in the contact process of making sulphuric acid, about 500,000 oz. being employed for this purpose towards the end of the war; losses of only 0.25 g. of metal per ton of acid made were reported, so that very little renewal was required. Platinum-iridium and nickel-chromium alloys, tungsten and molybdenum are gradually replacing platinum for use in the electrical industry, and in 1919 and 1920 in the United States over half the platinum consumed was used in making jewellery.

Iron and Arsenic in 1921

The following advance statistics, compiled by the Imperial Mineral Resources Bureau, show the world's production, imports and exports of iron and arsenic during 1921:—

IRON		1921
		Long tons
United Kingdom..	Production .. Pig iron ..	2,611,400
	Imports .. Iron ore, including mangiferous iron ore ..	1,887,574
	Pig iron, including ferro-alloys ..	681,955
	Exports .. Iron ore, including mangiferous iron ore ..	1,472
	Pig iron, including ferro-alloys ..	135,098
Union of S. Africa	Production .. Iron ore ..	2,157
	Imports .. Pig and ingot ..	1,023
Canada ..	Production .. Iron ore ..	38,337
	Pig iron and ferro-alloys ..	616,847
	Imports .. Iron ore ..	590,329
	Exports .. Iron ore ..	3,804
India ..	Imports .. Iron ore ..	9
	Pig iron ..	14,129
	Exports .. Pig iron ..	51,942
Australia ..	Production .. Iron ore ..	689,275
	Pig iron ..	352,365
	Exports .. Pig iron ..	2,765
Austria ..	Production .. Iron ore ..	670,000
	Pig iron ..	220,000
Belgium ..	Production .. Pig iron ..	862,305
France ..	Production .. Iron ore ..	13,879,000
	Pig iron ..	3,362,038
	Imports .. Iron ore ..	418,196
	Pig iron and ferro-alloys ..	37,266
	Exports .. Iron ore ..	5,212,845
	Pig iron and ferro-alloys ..	648,060
Germany ..	Production .. Pig iron and spiegel-elsen ..	8,000,000
Italy ..	Production .. Iron ore ..	275,480
Luxemburg ..	Production .. Pig iron ..	955,000
Norway ..	Imports .. Pig iron and ferro-silicon ..	5,889
	Exports .. Iron ore ..	188
	Pig iron and ferro-chrome ..	1,083
Soviet Russia ..	Production .. Pig iron ..	967,741
Spain ..	Imports .. Pig iron ..	24,135
	Exports .. Iron ore ..	1,795,428
	Pig iron ..	4
Sweden ..	Production .. Pig iron ..	3,036,000
Switzerland ..	Imports .. Pig iron ..	24,282
Algeria ..	Exports .. Iron ore ..	673,956
Tunis ..	Exports .. Iron ore ..	200,733
United States ..	Production .. Iron ore ..	29,547,000
	Pig iron ..	16,688,126
	Imports .. Iron ore ..	315,768
	Pig iron and ferro-alloys ..	44,516
	Exports .. Iron ore ..	440,106
	Pig iron and ferro-alloys ..	28,305

ARSENIC

		1921
		Long tons
Southern Rhodesia	Production .. White arsenic and arsenic in ore ..	1,331
Canada ..	Production ..	220
Queensland ..	Imports .. Metal ..	5
France ..	Production ..	5,116
United States ..	Imports .. Arsenic and sulphide of arsenic ..	2,985

The Uses of Cotton Linters

An account of the characters, production and uses of linters is given in *Departmental Circular* 175 (1921) of the U.S. Department of Agriculture. Linters, which consist of the fuzz of the cotton seed together with any cotton fibre that has escaped removing during ginning, are used for stuffing mattresses and cushions, making absorbent cotton, felt, low-grade yarns for wicks, rope, felt, and, as cellulose, for making artificial silk, paper and explosives. During the war linters were greatly in demand for explosives manufacture, and by the introduction of new systems of delinting the yield was increased from 25 to 75 lb. to 140 to 200 lb. per ton of seed. By the "suction" system the fibre is blown from all the different delinting machines, mixed and united into one uniform grade. Although this system has since been abandoned as it does not give a product in the form of a felt, being therefore only of use in explosives manufacture, its value in saving labour and giving a cleaner and more uniform product has been appreciated and a method has now been devised by which the linters are converted into a felt. From 556,000 bales, or 3.5 per cent. of the cotton crop in 1911-12, the output of linters in the United States increased to 1,331,000 bales (10.9 per cent.) in 1917-18, but fell to 7.7 per cent. of the crop in 1918-19 and 5.4 per cent. in 1919-20. At present production exceeds demand, but it is hoped that the paper industry will use large quantities of it, and that other commercial applications will be found.—(*Imp. Inst. Bull.* XIX, 4, 1921.)

Determination of Hydrosulphite

Messrs. Brotherton and Co., Ltd., of Leeds, have published a pamphlet relating to the methods of determining sodium hydrosulphite in use in their laboratories. The preparation of pure indigo-carmino solution and of the hydrosulphite solution for analysis are described. A special apparatus is sketched, its use explained, and the precautions necessary to avoid oxidation of the indigo carmino reduced during the determination are detailed. In the silver method of estimating hydrosulphites a silver solution is prepared by dissolving one gram of silver nitrate in 10 c.c. of distilled water and adding 15 c.c. of a 20 per cent. solution of ammonium hydroxide. This solution is poured on to about 0.4 gram of solid hydrosulphite and the whole is well stirred. After about 5 minutes the grey precipitate of silver is filtered off, washed thoroughly with dilute ammonium-nitrate solution until free from silver nitrate, dried, ignited, and weighed; 216 parts of silver are equivalent to 174 parts of pure anhydrous sodium hydrosulphite.

A New German Periodical

Under the title "Wissenschaft und Industrie," Plauson's Forschungs Institut, of Hamburg, is issuing a new monthly publication under the editorship of Dr. H. Schmidt devoted to scientific and

industrial research. The first number, published on July 15, contains articles by Plauson on the colour shown by colloid dispersions under the ultra-microscope, by Dr. H. Schmidt on corpuscular phosphorescence, and by Dr. J. Schmitt on a new organic reagent.—(*Chem.-Z.*, July 6, 1922.)

"Germanit"

In *Metall und Erz* (1922, 13, 324) Prof. Pufahl, of the Berlin Technical Hochschule, describes the results of his investigation of a copper-sulphide mineral occurring in considerable quantities at Tsumeb in South-West Africa and containing nearly as much germanium as the mineral argyrodite (Saxony) in which C. Winkler discovered that element. The new mineral is always found associated with zinciferous arsenical pyrites and has a dark reddish-green colour and a weak lustre. Analyses of two hand-picked specimens gave (per cent.): Cu 45.4, Fe 7.22, Ge 6.20, Zn 2.61, Pb 0.69, S 31.31, As 5.03, and SiO₂ 0.75. The name "Germanit" has been given to the mineral.

The Fertiliser Situation in Germany

In a recent debate in the Reichstag, the Minister of Food and Agriculture said that during the past fertiliser year synthetic nitrogenous fertilisers were utilised in greater quantity than in the years before the war. Supplies of phosphoric acid, although not so abundant as those of nitrogen, were twice as large as in the previous year, and would probably improve still further in the current season. Potash, as in former years, would be available in sufficient amount. Although prices of fertilisers had been kept stable during the past year and the prices of superphosphate, "Rhenania" phosphate, and bone meal had been temporarily reduced in June, 1921, the heavy costs of production and diminished output made great increases necessary at the end of the year. As doubt had been cast on the accuracy of the basis upon which the prices had been calculated, the question of evaluation was to be investigated. The value of fertilisers in maintaining yields was being increasingly recognised, especially among the peasantry, owing to propaganda work and demonstrations.—(*Chem. Ind.*, May 29, 1922.)

The Industrial Value of Ostwald's Colour Rule

Ostwald has proposed to replace the prevailing custom of describing colours merely from their appearance by a method which enables any colour to be expressed as a numerical quantity. In this method all the colours are arranged in a circle, starting from yellow and passing through orange, red, violet, ultramarine, blue-green, sea-green, yellow-green, to yellow again. If the circle is divided into 100 parts the "colour tone" of yellow is 00, of red 25, of blue 50, of green 75. Conceptions of lightness and purity of colour are expressed by means of letters. If one colour is merely lighter than a second the first contains more white; if pure in shade it contains more black. Thus 53 l c represents a colour of "tone" 53 with whiteness l and blackness c. Ostwald has also propounded rules for combining two colours to form a third and for making up colour schemes involving a number of colours. The German colour industry does not seem to have accepted the system on account of practical difficulties which arise probably because the personal factor is not entirely eliminated.

Treatment of Acute Benzene-Poisoning with Lecithin Emulsion

A workman, 37 years of age, who had inadvertently drunk 80 g. of benzene came under treatment 1½ hrs. after, and when the stomach had been washed out, 5 c.c. of 10 per cent. emulsion of lecithin was injected. After an hour the chief symptoms—coma, depressed pulse, cyanosis, etc.—had disappeared, and after 36 hours the only sign of the poisoning was a slight albuminuria, which disappeared after a few days. It is uncertain whether the lecithin combined with the benzene in the blood stream and thus prevented it from accumulating in the cells, or whether it removed the poison already deposited in the cells. No untoward consequences resulted from intravenous injection and the fear of a fat embolism proved ungrounded. Lecithin emulsion has also proved useful in a case of acute oxalic-acid poisoning.

The Glass Industry in Belgium

In 1921 the Belgian glass industry failed to maintain the level of exportation that had been reached in 1920, and the weight of glass exported was 39 per cent. less than in 1920 and 46 per cent. below that of 1913. Despite this decrease, Belgium regained, and even improved, its former position in foreign markets for plate and window glass and table ware; thus the export of window glass to the United States was over twice as much as in 1913. Imports in 1921 were 61 per cent. greater than in 1920 and 28 per cent. less than in 1913. France supplied all the rough plate glass, but Germany, though still leading, monopolised some lines and shared others with France, Great Britain, Holland and Austria. Details of the imports and exports in 1921 are appended:—

	1921	
	Imports	Exports
	Metric tons	
Plate glass	44.4 ..	24,529.4
Window glass	816.3 ..	111,003.3
Bottles	14,024.7 ..	2,374.7
Demijohns, wicker-covered	52.4 ..	32.6
Ware of green glass (not bottles) ..	163.7 ..	153.8
Table-ware	170.4 ..	18,087.7
Other glassware	2,503.6 ..	1,244.1
Total	18,680.6 ..	157,335.5
Value, francs	23,222,784 ..	271,665,662

Conditions in the Belgian glass industry were unfavourable during the first quarter of 1922; the demand was poor, prices were reduced by plate-glass factories in the United States, Germany and Czechoslovakia were competing strongly in flint and table glass, and prices of certain staple raw materials were rising. In the window-glass industry only 17 furnaces were operating, the plate-glass factories were working at about 50 per cent. of capacity and only five furnaces were producing special glass. Plants producing superior types of bottles were fully occupied, but those producing common bottles lost trade to Germany. In view of the increasing use of Fourcault machines—over 150 are being installed in various foreign countries—and of Libby-Owens plants, the future of the hand-blowing plants in Belgium is not promising. Current prices of raw materials (in francs per 100 kg.) for the glass industry are as follows:—Sodium sulphate 27; sodium bicarbonate 32.5; calcium carbonate, ground, 29; nitro, refined, 150; borax, crystallised, 157; fluorspar, ground, 25; felspar, ground, 21; cryolite 250; alumina, calcined, 280; manganese (87 per cent.), ground, 120 fr.—(*U.S. Com. Rep.*, Apr. 17, May 8, 1922.)

Sugar Crop of Mauritius

According to the final estimate issued by the Mauritius Department of Agriculture, the sugar crop for 1921-22 is placed at 206,000 tons, or 20 per cent. below the normal yield, and the smallest crop since 1904, when it was 190,000 t. The sugar content of the 1921-22 crop was only 10.2 per cent., the lowest recorded during the past 10 years. This decline is due to the severe drought during the summer of 1921.—(*U.S. Com. Rep.*, July 3, 1922.)

Chemistry in the Sudan

The work undertaken in the Wellcome Tropical Research Laboratories is very varied, ranging from the briquetting of charcoal (*cf.* J., 1921, 190 r) to wood preservation, sources of tannin, and cassava as a source of alcohol. Various samples of wood tar were examined in 1921, tamarisk wood yielding 8.9 per cent. of tar, which on distillation gave about 40 per cent. of tar oils and 60 per cent. of pitch—both products that could be utilised locally. The effect of the oils on wood as a protection against attack by white ants was tested and found to be inferior to that of coal-tar creosote; the method and material used, however, constituted a much more severe test than would be met in practice. Of the local sources of tannin, "dirini" bark (*Burkea africana*) has been examined, and the analysis gave, per cent.:—Moisture 6.5; ash 3.6; soluble solids 27.0; tannin 17.0. On account of the high price of petrol in South Sudan, bitter cassava (*Manihot utilissima*), a food crop grown in the Mongolia Province, was investigated as a source of alcohol. The material contained 72 per cent. of moisture and as the percentage composition of the dried material was:—Crude fibre 4.6; protein 5.5; ether extract 1.0; ash 3.5; carbohydrates 85.4, the material could probably be used as a source of alcohol.

Alcohol as Motor Fuel in Brazil

The National Brazilian Agricultural Society has recently completed tests relating to the value for motor fuel of a mixture of alcohol (95°) 65 parts, ether 25 parts, kerosene 9.5 parts, and pyridine 0.5 part. With this mixture, consumption per kilometre ton was 93.5 c.e., compared with 126 c.e. for gasoline, and the engine started easily and ran smoothly. With a mixture containing alcohol (95°) 83 parts, ether 10, kerosene 5, and pyridine 2 parts, difficulty was experienced in starting, the fuel consumption was 129 c.e. per kilometre ton, and the engine ran well only at the end of the test, which was carried out over a distance of 45.1 kilometres. Alcohol made from sugar-cane residues is sold at the Campos sugar factories in Brazil for about 275 reis per litre (about 9d. per gall. at current exchange), whereas gasoline costs 750 reis per litre in Rio de Janeiro (1000 reis=2s. 3d. at par, now 7.4d.; litre=0.22 gall.). The local factories could almost supply the needs of the Federal District and the State of Rio de Janeiro, their productive capacity being 5.5–6.0 million gallons of alcohol. At present, however, the output does not exceed 1.75–2.2 mill. galls., and much of it is wasted through lack of transport facilities. If alcohol motor-fuel is to be used on a large scale, the cost of production must be reduced by organising storage and supply facilities, and the composition of the alcohol mixture must be standardised so as to produce the same power as gasoline.—(*U.S. Com. Rep.*, May 15, 1922.)

PERSONALIA

Sir Robert Hadfield, Bart., has presented to the Metallografiska Institutet of Stockholm a scholarship of £150 per annum, tenable for two years, "as an expression of the debt of gratitude which the world owes to Swedish science."

Dr. J. Meisenheimer, professor and director of the Chemical Institute in the University of Greifswald, has been appointed to the chair of chemistry in the University of Tübingen, vacant by the death of Prof. W. Wislicenus, who had occupied it since 1903.

Engineer Vice-Admiral Sir George Goodwin, late Engineer-in-Chief of the Fleet, and Dr. J. C. Irvine, Vice-Chancellor and Principal of St. Andrew's University, have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

In the examination for the Fellowship of the Institute of Chemistry, held in July, Mr. P. D. Oakley passed in Metallurgy, and Messrs. R. E. Essery and J. R. Walmsley in the Chemistry and Microscopy of Food and Drugs, and Water. Twenty-eight out of 45 candidates were successful in passing the examination in General Chemistry for the Associateship, and 6 out of 9 candidates passed the examination under the regulations in force prior to March, 1920.

In the United States, Dr. J. A. Ambler has been appointed chemist in charge of the colour laboratory of the Bureau of Chemistry, in succession to Dr. H. D. Gibbs; Mr. C. E. Betz has been appointed chief chemist of the Pittsburgh Testing Laboratory; and Prof. C. S. Bisson has left the S. Dakota School of Mines to take charge of the Department of Chemistry in the Northern Branch of the University of California; Dr. G. L. Wendt, professor of chemistry in the University of Chicago, has been elected president of the Standard Oil Co. of Indiana.

Ramsay Memorial Fellowships, of the value of £300 each, have been awarded to Dr. R. W. Lunt, to continue his work at University College, London, on chemical effects of electromagnetic waves over the frequency range 10^2 – 10^4 cycles; to Mr. J. A. Mair, of Glasgow University, to pursue his research on the chemistry of the terpenes; and to Mr. W. Davies to continue his investigation on the preparation of synthetic reagents from the toluic acids. Fellowships have also been granted to Dr. J. O. Lublin and Mr. A. W. Berntson (Sweden); Mr. Dag Nickelsen and Miss M. Prytz (Norway); and Dr. C. S. Piggott, of Baltimore.

The British Research Association for the Woollen and Worsted Industries has awarded research fellowships to Mr. G. W. Chester, of Liverpool, to investigate wool fats at the University of Manchester; to Mr. J. L. Raynes, of Nottingham, to study the bleaching of wool at the University College, Nottingham; and to Mr. G. Barker, of Baildon, to conduct research at the University of Leeds on the effect of water on the strength, elasticity, lustre, dyeing properties, etc. of wool. Advanced scholarships have been awarded to Mr. A. Banks, Keighley, and Mr. W. E. Elliot, Hawick, tenable, respectively, at the Bradford Technical College and the Central Technical College, Galashiels.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for August 10 and 17)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Argentina ..	Earthenware	154
" ..	Disinfectants, sheep and cattle dips	156
" ..	Sulphuric acid, aluminium sulphate (tender for)	4390/F.L./C.C.
Australia ..	Perfumes in bulk	133
" ..	Perfumery, soap	161
" ..	Commercial sodium acetate (tender for)	9320/E.D./C.P.
Belgium ..	Paper	174
British West Indies	Steel sheets, tubes (tender for)	135
Chile ..	Enamelware, glassware, crockery, lubricating oils, tinplate, galvanised sheets	201
Egypt ..	Animal oil for denaturing ethyl alcohol (tender for)	8759/F.E.
Finland ..	Perfumery, polishes	177
Hungary ..	Copper sulphate	180
Luxembourg ..	Ferromanganese for iron and steel works	181
Mexico ..	Tin	160
" ..	Tinplate, black and galvanised sheets	202
Netherlands ..	Chile saltpetre (tender for) ..	15665/F.W./C.P.
Netherlands East Indies ..	Palut	153
New Zealand ..	Glassware	167
Norway ..	Tinplate, galvanised plates ..	142
" ..	Chemicals, iron and steel ..	F.R./5540
South Africa ..	Glass bottles, enamelware ..	169
Spain ..	Steel, tinplate, varnish, gums, shellac, fish oils	144
Switzerland ..	Raw materials for the chemical industry, intermediates for making coal-tar dyes ..	151
" ..	Pharmaceutical chemicals ..	152
United States ..	Fire-bricks, cement	198

TARIFF CUSTOMS EXCISE

Belgium.—The "coefficient of increase" applied to the duties on crystallised and granulated sugar has been reduced from 2 to 1·5.

Cyprus.—Imported fertilisers must be accompanied by a declaration of origin and the percentage contents of nitrogen, phosphoric acid, and potash in a soluble form.

Federated Malay States.—The import duties on matches have been revised.

Gold Coast.—The system of valuing goods for customs duty has been amended.

Ireland.—The Provisional Government has prohibited the importation, save under licence, of liquid fuels, lubricating oil, sheet metal, and iron plates.

Kelantan.—The import duty on limo has been raised from 3 per cent. to 10 per cent. *ad valorem*.

Memel Territory.—A list of customs duties applied to spirits, ether, salt, mineral and resin oils, and hides is given in the issue for August 10.

Newfoundland.—It is proposed to exempt imports of kerosene oil, gasoline, bark, bark extract, cutch,

potassium dichromate, and logwood from the sales tax of 5 per cent. *ad valorem*.

New Zealand.—Celluloid and other capsules are admitted duty-free under the British preferential tariff. The conditions under which dumping duties will be levied are set out in the issue for August 17.

Nigeria.—The export duties on hides and skins have been reduced.

Portugal.—Special surtaxes have been imposed on exports of cork, oilseeds, palm oil, and vinegar.

Portuguese East Africa.—The additional duties levied on imports of sugar, spirits, alcohol, edible oils, benzol, gasoline, dynamite, gunpowder, mirrors, lubricating oil, soap, candles, salt, vinegar have been modified.

Southern Rhodesia.—Recent amendments of the customs tariff affect corks, cinematograph films, medicinal preparations, essences, syrups and tinctures, and starch.

REPORTS

THIRD REPORT OF THE DEPARTMENTAL (HOME OFFICE) COMMITTEE ON LIGHTING IN FACTORIES AND WORKSHOPS. Pp. 38. London: H.M. Stationery Office, 1922. Cmd. 1686. Price 9d.

Commencing with a brief review of the recommendations contained in two previous reports (*cf.* J., 1921, 318 R), the present report is devoted principally to the classification of industrial processes according to the illumination they need, and to the effects of mixed natural and artificial lighting. For the present it is recommended that definite legal minima of illumination shall not be imposed for processes carried on in factories and workshops, but that a specification of minima as "recommended practice" for different groups of processes shall be issued. Schedules A and B, contained in Appendix 1 of the present report, covering "fine work," for which the recommended minimum illumination is 3 foot-candles, and "very fine work" for which a minimum of 5 foot-candles is recommended, are suggested as the basis of such specification. Only those industries have been scheduled in which at least one process was judged to be "fine work" or "very fine work." Thus the iron and steel industry is entirely excluded and very few, if any, distinctly chemical processes are scheduled. Although no definite recommendations are made respecting processes needing only moderate illumination, it is pointed out that if the recommendations of the first report are adopted, the illumination at floor level in workrooms cannot fall below 0·25 foot-candle.

No conclusive results indicating special effects of mixed lighting (partly artificial light and partly daylight) were obtained, and at present no definite recommendations can be made on this matter.

The customary use of a naked source of light appears to be unnecessary for the examination of glass sheets during the bevelling process, and it is suggested that glass-bevelling shops should comply with the recommendation, contained in the second report, for avoiding glare.

Owing to the need for economy, the inquiries of the committee are concluded for the present. It is pointed out, however, that hardship to employers

and administrative difficulties in the imposition of definite legal minima of illumination in workshops and factories would be largely avoided if a sufficient number of observations were collected indicating the best existing practice in the various processes, and if the conditions of illumination desirable on physiological and psychological grounds were investigated. The principal industries scheduled in Appendix 1 are invited to co-operate in this scheme by arranging for the collection of actual data, if possible through research associations.

REPORT ON PEAT BY THE COMMISSION OF INQUIRY INTO THE RESOURCES AND INDUSTRIES OF IRELAND. Pp. 110. Published by the Commission, 87, Grafton Street, Dublin. 1921. Price 2s. 6d.

Many attempts have been made to develop the Irish peat deposits on a large scale and a special report was made to the Fuel Research Board only last year (*cf. J.*, 1921, 229 n). All the attempts to manufacture pressed peat-briquettes have failed, and research has been directed towards the more efficient winning of peat by the use of machines of the Wielandt, Baumann, or other type, and the generation of cheap power in installations comprising either a water-tube boiler and turbo-generators or large gas-producers and gas-engines (*cf. J.*, 1920, 213 n).

The commission of inquiry considers that experiments should be made to determine how far the percentage of water in peat can be reduced by "bottom drainage," and would compel turbary owners to co-operate in drainage operations. A recommendation is made that one or more of the automatic machines which have proved so successful in dredging, forming and spreading peat should be acquired by the Irish State and tested carefully on the Irish bogs. Air-drying of peat, depending, as it does, on the climate, makes the peat-winning industry discontinuous, and well-considered experiments should be initiated from time to time with a view to devising some successful method of drying peat by artificial means, even though at present it would seem to be quite uneconomical to do so. The manufacture of peat charcoal has proved commercially successful, whereas carbonisation for the production of illuminating gas has been a failure. Another outlet for peat would be its use in pulverised form, either alone or mixed with powdered coal, although this would have to be confined to rotary kilns or locomotives, and would not apply to large power stations. The most promising method of utilisation seems to lie in gasifying the peat in producers, and using the gas in stations not exceeding a few hundred horse-power in capacity. For large stations, the use of turbo-alternators is advocated, although when the peat contains a high percentage of nitrogen, it might be advisable to gasify it in by-product recovery plants and to use the resultant gas for boiler-firing, the steam being then used in turbo-alternators as before. The Commission is of the opinion that four stations, each designed to carry about 20,000 kw. constant load, would more than suffice for Ireland's requirements of combined nitrogen for the manufacture of nitrogenous fertilisers and explosives. The establishment is advocated of at least one station of 20,000 kw.-capacity by the Irish State in a suitable locality, part of the electrical power developed to be utilised at the bog for manufacturing calcium

cyanamide and the remainder transmitted to centres of industry.

Moss-litter manufacture is commercially sound, but the Commission states that little hope can be entertained for any scheme for producing alcohol from peat. The cellulose constituents, on hydrolysis, yield unfermentable sugars, *e.g.*, arabinose, in addition to fermentable sugars such as glucose. It rarely happens that the percentage of dry turf which can be converted into alcohol exceeds 12 per cent. One ton of air-dried moss yields about 10 gallons of absolute alcohol, but the main expense is incurred in distilling the very weak wash, which contains only about 0.6 per cent. of alcohol.

The Bogs Commissioners of 1809-1814 recommended the utilisation of cutaway and virgin bog, a recommendation with which the present Commission agrees, whereas an agricultural sub-committee appointed by the Department of Agriculture and Technical Instruction for Ireland reported that the reclamation of virgin bog would not be remunerative even under the most favourable conditions, although the reclamation of cutaway bog might possibly be remunerative under certain conditions (*cf. J.*, 1921, 229 n). It is recommended that, in order to avoid speculation, the State should acquire all the larger bog lands of the country at bog value, and that a few very large bogs should be reserved by the State primarily for meeting national needs, and secondarily for carrying out national experiments on the utilisation of peat.

REPORT ON THE TRADE, INDUSTRY AND FINANCE OF SYRIA, DATED APRIL, 1922. By H. E. SATOW, H.M. Consul-General, Beyrout. Department of Overseas Trade. Pp. 25. London: H.M. Stationery Office, 1922. Price 9d.

Syria possesses no industries, coal or petroleum, and agriculture is undeveloped and primitive. Apricots, pistachio nuts, and wool are exported, but shipments of olive oil are declining owing to poor quality, and silk cocoons are produced for export to France and Italy. There is a certain amount of water power, but except at Damascus none is harnessed. The minerals include gold, copper, iron ore, manganese ore, chromite, gypsum, lignite (none of any value), and asphalt. Alluvial gold occurs in an extensive deposit near Antioch and panning tests are said to have yielded about 1.5 dwt. of gold per cb. yd. Large nodules of copper are found between Alexandrette and Aleppo, iron ore occurs to the north of the former town and manganese ore in Northern Syria, but neither of the two last-named minerals are suitable for industrial use. Chromite occurs abundantly, especially between Suedia and Alexandretta, and small amounts have been extracted. Gypsum is said to exist in quantity at Suedia and asphalt is found in many localities, especially at El Becheri on the Euphrates.

Until the mandate for Syria is confirmed and the political situation in the Near East becomes clearer, the country's commercial future cannot be foreseen, and trade statistics are of value only in showing what goods are required. Imports through Beyrout in 1921 were valued at £9,889,458 (£2,629,161 from Great Britain and £1,895,844 from France) and included iron and steel bars, copper bars, cement, tiles, window glass, matches, dyes, paint, chemicals and soap. Exports were valued at £553,843, of which nearly one-half was directed to France.

COMPANY NEWS

The British Cyanides Co., Ltd.

The directors report states that the company's Tat Bank Factory was closed down throughout the whole of the year ended April 30, 1922, and that owing to foreign competition in potassium compounds it has not been reopened. The Pope's Lane Factory was reopened in August, 1921, and is now operating on a profitable basis. New processes have been worked out on a small scale for the manufacture of refined potassium compounds; one such compound is now being made by electrolysis on a profitable scale.

The experiments on the barium process for the fixation of atmospheric nitrogen have been energetically pursued and, although seriously hindered by the crises in the coal and engineering trades, have given definite results of a satisfactory nature. The merits of the new type of furnace designed by Sir Arthur Duckham have been proved and the directors believe that this great problem will be solved during the current financial year.

Severe competition in foreign potash having made it necessary to close down the works of the British Potash Company, Ltd. during the year under review, active negotiations have been entered into and are now in progress which, if successful, will enable the company to recommence operations on a satisfactory basis, but these negotiations are being conducted under considerable difficulties owing to the unsettled state of Europe.

The company has embarked upon the merchanting of foreign chemicals, and the profits earned during the year covered the initial heavy expenditure. The total net profit for the year was £2383, and after meeting the dividend on the preference shares there remains a balance of £492 to be carried forward.

Minerals Separation, Ltd.

At the 17th ordinary general meeting, held in London on July 29, Mr. F. L. Gibbs, chairman, described the success of the company's new processes for treating coal. The company had now a perfect system of cleaning fine coal; a system that would solve the problem of reducing the moisture-content of fine coal; and a new system of manufacturing briquettes which was less expensive and produced a much purer fuel than the present method. The trials of the briquetting system, carried out in conjunction with the Powell Duffryn Steam Coal Co., had been very satisfactory. Ground coal mixed with 50 per cent. of water was briquetted in a press, all the water, save about 4—5 per cent., was expressed as a clear jet, and the resulting briquettes became so hard in a few hours that they could be thrown about without breaking. The amount of binder required was only about one-third of that usually employed, and the briquettes made from coals belonging to the Powell Duffryn company could be obtained with only about 3 per cent. of ash and 3 per cent. of moisture. It was unnecessary to dry the coal before briquetting and no pugmills were required. A plant with a daily capacity of at least 2000 tons of the new patent fuel ("Minseps") was to be erected on a site already acquired in Wales. The fuel had been tested on a Welsh railway passing up steep gradients and had given great satisfaction.

TRADE NOTES

BRITISH

Leeward Islands in 1920-21

Antigua suffered from severe and prolonged drought during 1920-21, and consequently the sugar crop was so reduced that only the abnormal prices ruling for sugar saved the industry from serious loss. Exports from Antigua included:—Sugar, molasses and syrups £314,562; cotton £16,362; hides and skins £1782; lime juice £1079; and green limes £246. High prices were again obtained for the sugar (12,483 tons) and cotton (251 t.) produced in St. Kitts and Nevis, but the fall in prices of all tropical products seriously affected the planters in Dominica and the export of lime products declined in value by £10,991 to £185,410; these products included lime juice, concentrated, 154,040 gallons, raw, 273,082 galls.; citrate of lime 304 t.; essential oil of limes 22·6 t.; and otto of limes 9 t. The factory established in St. Dominica by L. Rose and Co. for making citric-acid crystals should prove successful, as over 84 per cent. of the export of lime products in 1919 and 1920 consisted of concentrated juice and calcium citrate. Coconut-growing offers great possibilities in Dominica, but has received little attention; the export of coconuts increased by 214,553 to 706,979, which constitutes a record. Cotton is the chief product of Montserrat and the export was 248 t.; other exports were:—Lime juice 96,851 galls.; concentrated lime juice, citrate of lime, fresh limes £2734; muscovado sugar 116 t.; and papaine 821 lb. Good progress was made in extending the area under cultivation in the Virgin Islands; the cultivation of coconuts is spreading, but cotton is still the chief crop.—(*Col. Rep.-Ann.*, No. 1074, 1922.)

FOREIGN

Exports of Soap, Oils and Fats from Germany

Official statistics give the German exports of soap, oils, fats and related products during the first quarter of 1922 as follows:—

	Jan.-Mar., 1922	
	Metric tons	Mill. mk
<i>Soaps:—</i>		
Soap in cases and jars ..	1817·9	.. 63·2
Hard soap, solid creolin, fat lye powder, etc. ..	143·1	.. 2·7
Soft-soap, liquid creolin, etc. ..	348·7	.. 6·0
Toilet soap, alumina soap, etc. ..	467·4	.. 11·6
Total ..	2772·1	.. 84·4
<i>Related products:—</i>		
Pollishes etc. ..	546·8	.. 16·9
Glycerin and soap by-products ..	263·2	.. 14·2
Cart grease ..	76·1	.. 0·3
Lubricants prepared with oils or fats ..	600·7	.. 8·4

The total export of soap in 1920 was 4121·5 t., valued at 55·7 million marks. Danzig, Memel, the Saar district, Luxembourg, Switzerland, and other adjacent States are the chief markets for German soap products.

Dyes in the Red-Sea District

Prior to the war over 800,000 lb. of dyes, valued at £38,000, was imported annually into the Red-Sea district through Aden. The dyes were chiefly lac scarlet, vegetable indigo and saffron from India, but Germany supplied all the aniline red and synthetic indigotin. Following the war, importations declined to 162,671 lb. in 1919-20, but im-

proved to 523,503 lb. in 1920-21, the shipments originating as follows:—Aniline red: Bombay 198 lb., United Kingdom 1296 lb., Austria 3248 lb. Lac scarlet: India 473,872 lb. Vegetable indigo: India 25,984 lb. Synthetic indigotin: Austria 10,524 lb., Belgium 3248 lb. Saffron: India 133 lb. Germany is reported to be regaining a footing in this market.—(*U.S. Com. Rep.*, June 12, 1922.)

German Exports of Red Lead, Zinc Dust, and Bronze Powders from January to March, 1922

Destination	Red Lead	Zinc Dust	Bronze Powders
	Metric tons		
Austria	159.1	70.1	—
Belgium	—	119.8	7.1
Czechoslovakia ..	172.1	—	—
Denmark	32.1	—	3.1
England	—	—	17.4
France	—	—	9.5
Holland	93.0	1466.2	9.8
Italy	—	—	19.7
Spain	—	—	2.9
Sweden	57.8	10.4	2.2
Switzerland	—	—	9.6
S. E. Asia	70.3	—	—
United States ..	—	—	122.4
Other countries ..	374.5	508.4	39.0
Total	868.8	2183.9	243.3
Value. mil. mk. ..	25.1	24.6	28.3

The total amount and value of the exports of the above products during 1920 were:—Red lead, 3370.4 t., 35.3 mill. mk.; zinc dust, 4261.2 t., 19.3 mill mk.; bronze powders, 832.7 t., 49.9 mill mk.

GOVERNMENT ORDERS AND NOTICES

EXPORT OF FERTILISERS.—The Board of Trade has issued an open general licence authorising the exportation to all destinations of basic slag; superphosphate of lime; and manures, compound, containing either basic slag or superphosphate of lime.

PHOSPHATE DEPOSITS IN MOROCCO.—A copy of the *Bulletin Officiel* (No. 503, June 15), containing a report on the work of the Sherifien Office of Phosphates during 1921, may be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

CHEMICAL WORKS REGULATIONS, 1922.—The Home Secretary has issued Regulations for chemical works dated July 11, 1922, which constitute the final form of the draft Regulations issued in December, 1920, and in March, 1922. Copies may be obtained from H.M. Stationery Office, price 4d.

SAFEGUARDING OF INDUSTRIES ACT.—Part I.—The Board of Trade has received a complaint under Section I (5) that acetic acid of 80 per cent. grade or higher has been improperly excluded from the lists of dutiable articles. The complaint will be submitted to the Referee, and any person directly interested should communicate immediately with the Assistant Secretary, Board of Trade (Industries and Manufactures Department), Gt. George St., S.W. 1.

INTERNATIONAL EXHIBITION OF LIQUID FUELS IN PARIS.—This exhibition, which is being organised by the Société de Chimie Industrielle in connexion with an International Congress on Fuels (October 9—15), will be held in Paris from October 4 to 15. Applications for space should be made to Monsieur J. Gérard, Commissaire Général, 49, Rue des Mathurins, Paris, and all particulars can be obtained from the Department of Overseas Trade (Exhibitions and Fairs Division), 35, Old Queen Street, S.W. 1.

REVIEWS

- (1) **ENGINEERING STEELS.** By LESLIE AITCHISON. Pp. xxii.+390. London: Macdonald and Evans, 1921. Price 25s. net.
- (2) **METALLOGRAPHY.** By C. H. DESCH. *Text-books of Physical Chemistry*, edited by Sir W. Ramsay and Prof. Donnan. Third edition. Pp. x+440. London: Longmans, Green and Co., 1922. Price 16s. net.

(1) This book is published in the Reconstructive Technical Series, the aim of which is to diffuse the new knowledge and enlarged technical skill gained during recent years and so make it available for the practitioner of to-day, as a means towards greater all-round efficiency and increased competitive power in the world's markets. The series is published under the editorship of G. W. de Tunzelman. Each volume is designed to serve a particular trade or vocation, the present volume dealing with steels from the engineer's point of view and providing the information which the engineer should possess in order to enable him to understand the steels which he is using. Prof. W. C. Unwin has written the foreword in which he compares modern requirements with those of the days of wrought iron. The developments in engineering practice during the last twenty years have resulted in the necessity for steels capable of performing higher duties than the older-fashioned plain carbon steels, and the requirements of the automobile and aircraft industries in particular have created a demand for steels possessing high orders of mechanical properties. This demand for high-quality steels has led to extensive inspection and the compilation of many specifications. The earlier specifications merely aimed at securing stipulated mechanical test results but the modern requirements must necessarily include correct chemical composition and correct heat treatment.

The purely metallurgical portions of the subject are dealt with very briefly; for instance, steel-making processes occupy fifteen pages, and this chapter seems a little unbalanced as more than five of these pages are devoted to the Bessemer process which is of minor importance in connexion with the type of steels mainly dealt with in the book.

The casting and working of steel receive attention, the solidification of molten steel in ingots being followed out in detail together with the nature of the crystallisation which takes place and its bearing on the properties of the resulting metal. This is of particular importance for its bearing on the position of planes and zones of weakness in the ingot, which may become the centres of definite defects. The effect of work, such as forging, on the crystals situated in different parts of the ingot and on the mechanical properties of the steel is described.

The chapter devoted to the heat treatment of steel occupies fifty pages, the thermal equilibrium diagram of the iron-carbon system and the effect of alloying elements on the hardening of steel receiving attention. Mass and volume effects in heat treatment and the engineering value of hardened and tempered steels are also discussed. The methods used for the mechanical testing of steel receive considerable attention as it is recognised that the metal will finally be judged by its mechanical properties, and from the engineer's point of view the details of composition, heat treatment, etc. are only of

secondary value. The tests which have recently become so important to the engineer, such as hardness, impact, alternating stress, and other tests are dealt with and the mechanical properties of steel are described, the definitions of the British Engineering Standards Association for elastic limit and yield point being used. A chapter is devoted to plain carbon steels in which the effect of varying carbon, high and low manganese, mass, etc. is described and followed by details of the mechanical properties of certain steels of selected compositions. A separate chapter is devoted to the important subject of alloy steels, and in this a classification is used based on the maximum stress obtainable with the steels. Steels with air-hardening properties are described in detail. Nickel-chrome steels receive most attention, but nickel, chrome-vanadium and "stainless" or high chromium steels are also described.

Case-hardening is of considerable importance to the engineer, especially for the lighter forms of machinery, and the operation itself, the carburising mixtures, the temperature necessary, the steels suitable, and the after-treatment of the case-hardened parts receive attention. The influence of cold work on the mechanical properties of steel is of greater importance than is generally realised, and cold worked material, in the form of bright drawn bar, is largely used in the manufacture of comparatively unimportant parts, particularly those in automatic machines. The changes in mechanical properties produced by varying amounts of cold work and also by reheating to temperatures below the critical range, that is, in the operation of blueing, are illustrated by tables and curves. The concluding chapter deals with tool steels, and in this chapter it appears that a disproportionate amount of attention has been given to plain carbon tool steels and too little to self-hardening and high-speed steels.

The book contains fourteen appendices, on such subjects as the influence of sharp corners and scratches on mechanical properties, Young's modulus of elasticity, the properties of steels at high temperatures, various classes of machines for impact testing, determination of hardness; and the last one consists of a bibliography of original papers on the hardness of metals. It is illustrated by a number of photomicrographs and photomicrographs showing crystalline structure of ingots, defects met with in ingots and forgings, effect of heat treatment and similar subjects; it is a pity that among such an excellent series of photographs, a very poor hand-drawn representation of pearlite has been inserted.

This book should prove to be very useful to engineers requiring a knowledge of the possibilities of modern steels and to metallurgists requiring definite knowledge of the more recent methods of testing metals. The subject could have been treated from a somewhat broader point of view, as it must not be forgotten that the engineer has many requirements not covered by aircraft and automobile specifications, which appear to constitute the chief interests of the author.

(2) This third edition of Professor Desch's well-known book on metallography will be welcomed by all interested in the subject because in it the most important results of recent investigations and references to recent publications have been incorporated.

The last edition appeared in 1913; since then the demands for the book have been met by a new impression of the second edition, published in 1918. The most important changes have been made in the chapters dealing with the physical properties of alloys, with corrosion and with the metallography of iron and steel. With reference to the physical properties of alloys, further information is added on hardness, a subject which has received considerable attention during the last few years. The subject of corrosion also receives further treatment, the work of the Corrosion Committee of the Institute of Metals being specially referred to. In the chapter on the metallography of iron and steel, the results of the study of the space lattices by the X-ray method have been added. The actual amount of new material in this edition is not great and its increased value is due to small additions and modifications together with references to the latest work. There is probably no one with a better knowledge of the literature of the subject than the author, and his tables of alloy systems contained in the appendix of 24 pages are probably more frequently referred to by metallographers than any other published matter on the subject.

C. O. BANNISTER.

INORGANIC CHEMISTRY. By T. MARTIN LOWRY. Pp. x+943. London: Macmillan and Co., Ltd., 1922. Price 28s. net.

To everyone engaged in teaching senior students the appearance of a new book on advanced inorganic chemistry by an author of reputation is an event of very real interest. For in spite of all the developments of chemical science inorganic chemistry must remain common ground to all chemists, and no chemical education can exclude the study up to a certain point. It is, however, becoming always more difficult to fix the reasonable limits and to assort from the overwhelming mass of material such a body of facts as should be brought to the notice, and to a large extent be established in the memory, of the student. There is also the difficulty of deciding how much of the general theory of chemistry, which in recent times it has been the growing habit to detach as "physical chemistry," should be elucidated in connexion with the facts, processes and applications of inorganic chemistry. There is here a great demand on the sense of proportion of the author and, be it added, on the consideration of his critics. Finally when the selection has been made there remains the crowning task of presenting the material with the utmost lucidity, coherence, and interest attainable within the limits of a book of marketable price.

Professor Lowry has evidently taken very great pains with his book, he has secured valuable assistance from a number of highly competent authorities and he has achieved his task in rather less than a thousand well-written, well-printed, and well-illustrated pages. As soon as the book appeared the present writer read the first 200 pages and has since devoted many short periods to sampling the rest. As the result he is inclined to rate the book very highly indeed, and—though he awaits the experimental trial with students for a final judgment—to place it as a strong competitor for the first place among all books that attempt the same object, subject only to the price not proving prohibitive.

It is not easy to state fully the grounds on which this judgment is based, but they are mainly two; first that Dr. Lowry exhibits what seems to be a very wise choice of material and secondly that he gives the impression of having not merely assembled it but of having exercised a critical judgment upon it and given to a great deal of it the impress of his own mind. It is inevitable that there should be the defects incidental to a necessary compression. So far as the historical side is concerned this is fully compensated by the fact that it drove the author to publish separately his *Historical Introduction to Chemistry*, a book of high and enduring value. But the physical chemistry of the present volume is so compressed that much of it can only rank as a reminder of what must have been learned, under more degrees of freedom, elsewhere. One can see also how the author has been under constraint in his excellent handling of practical applications. But to get an idea of what confronts the writer of a text-book on inorganic chemistry to-day consider for example what you are to do with iron. Think of the advance of knowledge in thirty years! What are you to say about its metallurgy—what about the various steels—are you to say that gamma iron differs from the alpha and beta forms in being constructed on a face-centred cubic lattice—and if you do, are you to elucidate the statement? At every point facts that you would like every student to know stand in queues, waiting for admission, in no clearly rightful order of precedence.

Professor Lowry has adorned his book with a number of beautiful pictures of minerals. They will have the effect of stirring the memory and exciting a salivary flow in those who have been nurtured and subsist on a less splendid mineral diet than is here portrayed. But to those who have not seen the things at all in reality, what is really to be got from these pictures? Perhaps Dr. Lowry will consider the advisability of replacing in a future edition some at least by the beautiful microphotographs of Sir George Beilby's recent book.

Very few minor errors have been noticed and no really indictable offences of commission or omission have obtruded themselves during this first examination. On the question of price it is to be hoped that the publishers are competent judges and that Professor Lowry's book may be put to the extended trial that it certainly deserves.

ARTHUR SMITHELLS.

BEITRÄGE ZU EINER KOLLOIDCHEMIE DES LEBENS. By DR. RAPHAEL ED. LIESEGANG. Second edition, revised. Pp. 39. Dresden and Leipzig: Theodor Steinkopff, 1922. Price, paper, 1s. 2d.

This pamphlet discusses the bearing of colloid chemistry upon the problems of its relations to living matter. The pamphlet begins with an introductory section on diffusions, followed by five different sections under the following heads:—(2) Diffusions with chemical exchanges, (3) Lime precipitation in gelatin gels, (4) Stratified structures, (5) Crystallisation in gels, and (6) Dissimilation, assimilation, and membrane action. The author has, on the whole, treated the subject with clearness, the material is well selected, and references to the literature are given where necessary. It will undoubtedly prove a useful and interesting summary to all those seriously interested in the subject.

DINSHAW R. NANJI.

CHEMISTRY OF RADIOACTIVE SUBSTANCES. By A. S. RUSSELL. Pp. xi+173. London: John Murray, 1922. Price 6s. net.

Dr. Russell has written an "Introduction to the Chemistry of Radioactive Substances" in a series of 12 chapters covering about 170 pages. It is perhaps a sign of the way in which this subject has developed that the present volume, instead of being a monograph, with detailed references to almost every paper that has been issued, takes on the familiar form of an elementary text-book, and does not profess to do more than provide an introduction to the study of the subject.

Dr. Russell possesses in a special degree the two qualifications that are needed to make a success of such an enterprise, namely, a complete knowledge of the subject with which he has to deal and considerable experience in explaining scientific phenomena to non-technical readers. In this volume he has fulfilled in an excellent way the task he has set before him, and, although the student must look elsewhere for references to serve as an index to the original literature, he will, after mastering Dr. Russell's book, have obtained a knowledge of the subject which is amply sufficient for any chemist who does not propose to undertake original work in this field.

T. M. LOWRY.

PUBLICATIONS RECEIVED

THE PETROLEUM AND ALLIED INDUSTRIES. By JAMES KEWLEY. *Industrial Chemistry Series*, edited by Dr. S. Rideal. Pp. 302. London: Ballière, Tindall and Cox, 1922. Price 12s. 6d.

CALCULATIONS OF QUANTITATIVE CHEMICAL ANALYSIS. By L. F. HAMILTON and S. G. SIMPSON. *International Chemical Series*. First edition. Pp. 196. New York and London: McGraw-Hill Book Co., Inc., 1922. Price 10s.

DOCUMENTS AND THEIR SCIENTIFIC EXAMINATION. By C. AINSWORTH MITCHELL. Pp. 215. London: Charles Griffin and Co., Ltd., 1922. Price 10s. 6d.

KOLLOIDCHEMIE, 1914—1922. By DR. R. E. LIESEGANG. *Wissenschaftliche Forschungsberichte*. Vol. VI. Pp. 100. Dresden and Leipzig: Th. Steinkopff, 1922. Price, paper, 3'4s.

DIE METHODEN ZUR HERSTELLUNG KOLLOIDER LÖSUNGEN ANORGANISCHER STOFFE. By DR. THE SVEDBERG. Third edition. Pp. 507. Dresden and Leipzig: Theodor Steinkopff, 1922. Price 13s. 2d.

THE NATIONAL PHYSICAL LABORATORY. COLLECTED RESEARCHES. Pp. 354. London: H.M. Stationery Office, 1921. Price 20s.

THE MINING LAWS OF THE BRITISH EMPIRE AND OF FOREIGN COUNTRIES. VOL. III. PART I. GENERAL PRINCIPLES APPLICABLE TO SOUTH AFRICA: THE TRANSVAAL. *Imperial Mineral Resources Bureau*. Pp. 400. London: H.M. Stationery Office, 1922. Price 30s.

IRON ORE. SUMMARY OF INFORMATION AS TO THE PRESENT AND PROSPECTIVE IRON-ORE SUPPLIES OF THE WORLD. *Imperial Mineral Resources Bureau*. London: H.M. Stationery Office, 1922. PART VII.—FOREIGN AMERICA. Pp. 136. Price 4s. PART VIII.—FOREIGN ASIA. Pp. 79. Price 2s. 6d.

REVIEW

Vol. XLI]

SEPTEMBER 15, 1922

[No. 17

CHEMISTRY AT THE BRITISH ASSOCIATION : HULL, 1922

At the ninetieth meeting of the British Association for the Advancement of Science, held in Hull from September 6 to 13, Prof. J. C. Irvine, F.R.S., Principal of St. Andrews University, delivered the presidential address to Section B (Chemistry). The following abstract of this address was prepared under the author's supervision, and the succeeding abstracts are those of papers presented to the same meeting by workers in Principal Irvine's laboratories.

PRESIDENTIAL ADDRESS TO SECTION B

PART I—The Organisation of Research

LOOKING back on the sixty-nine years which have elapsed since the British Association last met in Hull, it is evident that, in the interval, a revolution has taken place in the public and official attitude towards scientific research. The change has come rapidly, but it was not spontaneous. Many years had to be spent in disseminating the idea that scientific research is a vital necessity, and toward this end Presidents of the British Association have added the weight of their influence and eloquence. Although many other factors have doubtless played a part in creating a research atmosphere in this country, the work of the British Association has not been the least important.

Scientists have been given the opportunities they desired now that the State, acting through the Department of Scientific and Industrial Research, provides facilities for graduates to take a part in advancing scientific knowledge. Chemistry bulks largely in each of the research organisations operative in this country, and the future of our subject is intimately connected with their success or failure. We are at the beginning of a new phase in research, which has become a unit in our national scheme of education, and chemists must not forget that in consequence fresh responsibilities devolve upon them. By their own efforts they must justify what has been done.

The Government grants are awarded generously and widely, and there is a rush to chemical research in our Colleges, but no matter how great the enthusiasm and ability of these young graduate workers, they have to be trained, guided and inspired, if their research period is to be spent to the best advantage. Help of this kind can come only from the man of mature years and experience, and the duties of such a supervisor cannot be light. He must possess versatility, must command the ready sympathy

and understanding which enable him to enter into the beginner's difficulties, and he must avoid the temptation to use the research student as a scientific labourer.

Experience has shown that young research graduates require firm handling, and that constant effort is necessary to secure that they work in a business-like manner, keep proper records, and avoid extravagance and waste. The fulfilment of these requirements absorbs the main energies of the research supervisor, who is called upon to sacrifice his leisure and, in large measure, his own private research. The success of the scheme will be imperilled if our Universities and Colleges fail to realise this and are unprepared to afford members of the professor or lecturer class, who join in the movement, relief from formal teaching and administrative duties. Otherwise, we shall have made the mistake of focussing unduly on the research apprentice to the neglect of the interests of the mature investigator.

To secure these ends it is suggested that, in each institution, there should be a board or standing committee entrusted with the supervision of research. The functions of such a body would be widely varied and would include :—

1. The allocation of money voted specifically from university or college funds for research purposes.

2. The power to recommend additions to the teaching staff in departments actively engaged in research.

3. The recommendation of promotions on the basis of research endeavour.

4. The supervision of regulations governing higher degrees.

Among the more specific problems which would confront such a Board are :—

1. The creation of research libraries where reference works can be consulted immediately.

2. The provision of publication grants, so that where no periodical literature is available, the work will not remain buried or obscure.

3. The allocation of travelling grants to enable workers to visit libraries, to inspect manufacturing processes, and to attend meetings of the scientific societies.

PART II—Some Research Problems in the Carbohydrates

CELLULOSE—STARCH—INULIN

Twenty years ago, the first paper on the alkylation of sugars was given by Purdie and Irvine to the meeting of the British Association in Belfast. The principles then communicated have since proved of wide application in furnishing well-defined evidence of the structure of sugars and their derivatives, so that one by one the natural groups of carbohydrates have been studied by this method. As a result, ideas regarding the constitution of these compounds have become more secure and more definite. Simple sugars, glucosides and disaccharides have all been brought under review, and the results now submitted justify the application of structural formulæ to cellulose, starch and inulin.

CELLULOSE

(with W. S. Denham and E. L. Hirst)

The difficulties which stand in the way of ascribing a molecular constitution to cellulose are too numerous to mention, but the stability of the complex, coupled with its limited solubility and lack of volatility, are outstanding obstacles. Although it is obvious that real progress can come only as a result of patient and systematic research, and that impetuous theorising does infinite harm, many suggestions have nevertheless been put forward to represent the polysaccharide structurally.

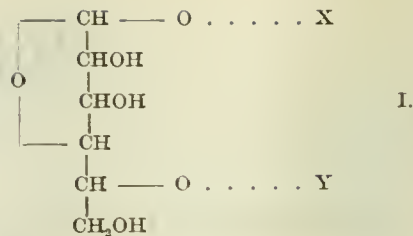
A necessary preliminary to speculation on the formula of cellulose is to ascertain if the aggregate $(C_6H_{10}O_5)_n$ is composed entirely of glucose units. The required evidence has been obtained, as cotton cellulose has been converted into pure crystalline methylglucoside, the yield of which is 95 per cent. of the theoretical amount. Structures which are unrelated to glucose can therefore be disregarded and the various formulæ for cellulose may be appropriately divided into three classes:—

1. Constitutions modelled on that of the glucosides, involving the addition of numerous glucose residues by mutual condensation. According to this view, cellulose consists of large molecules.

2. The unit of cellulose may be regarded as a simple anhydro-glucose, $C_6H_{10}O_6$, highly polymerised.

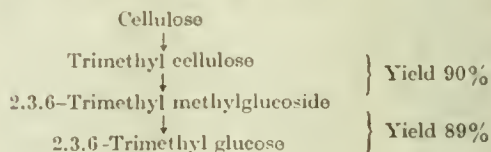
3. The unit has been claimed to be a simple anhydro-*n*-saccharide (where *n* is a small multiple), polymerised in unknown numbers.

In 1910 Dr. W. S. Denham succeeded in alkylating cellulose and obtained a derivative containing 25 per cent. of methoxyl. This, on hydrolysis, yielded a mixture of methylated glucoses from which 2,3,6-trimethyl glucose was isolated. Denham's work thus gave the first clear evidence as to the linkage of part of the cellulose molecule which must contain the unit:—

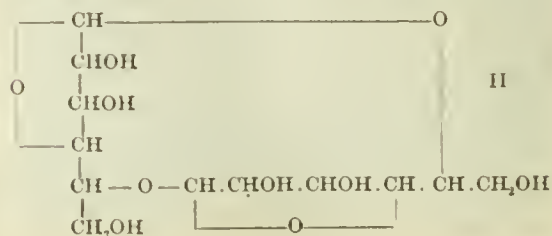


His research left unexplained the nature of the residues X and Y, and the investigation was, therefore, continued. In consultation with Dr. Denham, we find that the exhaustive methylation of the polysaccharide, when repeated twenty times, gives a product containing 43.0 per cent. of methoxyl in place of 45.6 per cent. required for a trimethyl-derivative. The carbon and hydrogen values also agree with the formula $(C_6H_7O_5(OMe)_3)_x$ and, as the material preserved a fibrous structure, there is little likelihood that profound molecular alteration had taken place. The trimethyl cellulose was then submitted to simultaneous depolymerisation, hydrolysis, and conversion of the scission products into the corresponding methylglucosides. These were distilled in a high vacuum, the total yield obtained being 90 per cent. of the theoretical amount. The distilled material consisted of 2,3,6-trimethyl methylglucoside and *no trace of tetramethyl methylglucoside was present*.

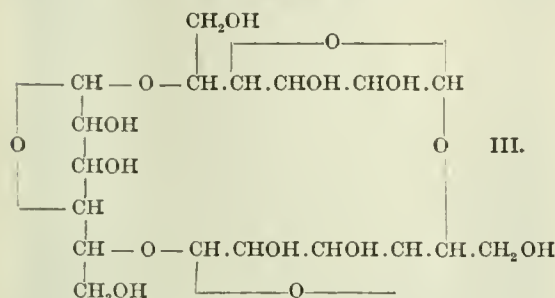
On hydrolysis of the distilled glucoside, an 89 per cent. yield of crystalline 2,3,6-trimethyl glucose was obtained showing $[\alpha]_D +108^\circ \rightarrow +67.0^\circ$. *No isomeric trimethyl glucose was present: higher and lower methylated glucoses were absent*. The reactions involved in the research are shown below, and considering the nature of the operations involved the yields may be claimed to be quantitative.



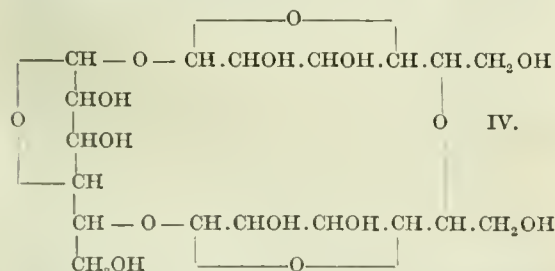
The scheme affords a proof that all the glucose residues in cellulose are identical in structure and have the hydroxyl groups 2, 3, and 6 unsubstituted. To satisfy this condition and to account for the formation of cellobiose, it is necessary to include in the formula at least two glucose residues. This is fulfilled by the structure II.



In terms of the above, 100 parts of cellulose should give 105.5 parts of cellobiose, and here the difficulty is encountered that the yields of this disaccharide are extremely variable and rarely exceed 35 per cent. The highest claimed is of the order 50—60 per cent. and, in the meantime, it is prudent to select a formula for cellulose which will give a result only slightly higher than this figure. We, therefore, propose the symmetrical tri-1.5-anhydro-glucose for the unit of cellulose on the ground that this structure would give a 70 per cent. yield of cellobiose as the theoretical maximum.



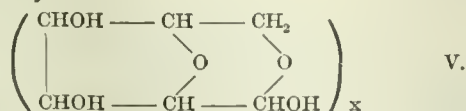
There is, however, an alternative method of coupling the glucose residues and this gives the structure shown below :—



Taking into account the fact that it can yield only one disaccharide, we prefer Formula III. The essential properties of cellulose, so far as they are displayed in chemical reactions, are accounted for by both formulæ.

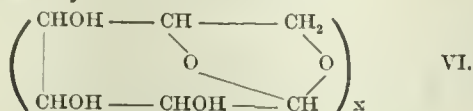
Various formulæ which have been previously suggested for cellulose are excluded by the results now submitted. Selected examples are :—

Green's formula :—



which would give a trimethyl cellulose and, on hydrolysis, would be converted into 3.4-dimethyl glucose of the amylenoxide type.

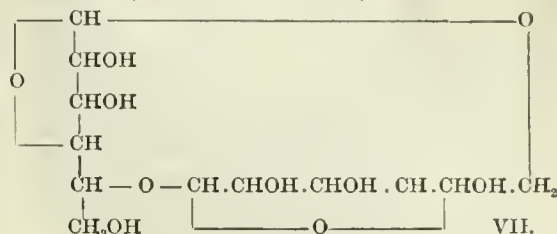
Vignon's formula :—



is equally unsatisfactory in that the final product

should then be 2.3.4-trimethyl glucose of the amylenoxide type.

The formulæ proposed by Tollens, Cross and Bevan, Bartelemy and Pictet are unsuitable for similar reasons. It is also possible to dispose of Karrer's formula which is that of an anhydro-cellobiose (termed "cellosan")



A compound possessing this structure would yield on methylation and hydrolysis :—

1 molecule of 2.3.5-trimethyl glucose, and 1 molecule of 2.3.6-trimethyl glucose.

Our experimental evidence is completely opposed to this view.

An entirely different type of formula for cellulose has been proposed by Hess, who regards the polysaccharide as a complex glucoside. The feature common to all such glucosidic formulæ is that the hydroxyl groups are not symmetrically distributed in the glucose residues. The simplest structure suggested by Hess would give, by our processes, five molecules of 2.3.5.6-tetramethyl glucose and one molecule of glucose, whilst his more elaborate molecules would produce these same compounds together with trimethyl glucose. The reactions of trimethyl cellulose exclude all formulæ of this nature.

STARCH

(with John Macdonald)

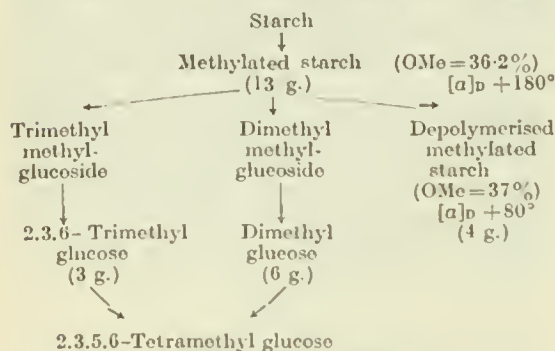
Turning to the problem of the constitution of starch, we encounter very much the same difficulties as have already been referred to under the heading of cellulose. At the present time there is little tendency to regard starch as a highly complex glucoside in which a large number of hexose residues are mutually condensed together, and the view prevails that the polysaccharide is derived from a comparatively simple anhydro-sugar by profound polymerisation. Attention may be focussed on three formulæ based on such ideas.

The unit of starch has been claimed to be :—

1. β -glucosan (Pictet).
2. anhydro-maltose (Karrer).
3. triamylose (Pringsheim).

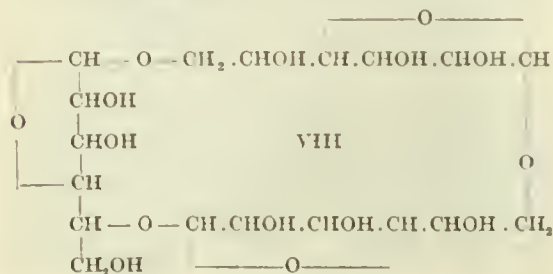
It is possible to test these views by the methylation method. When the polysaccharide is methylated repeatedly the reaction ceases when the methoxyl content is 37 per cent. Now, this value for methoxyl corresponds exactly with the theoretical amount calculated on the basis that one hexose residue has acquired three

methyl groups whilst four are shared by two glucose residues. Ultimate analysis is also in agreement with this view. Hydrolysis of the methylated starch has shown that this is not a fortuitous coincidence, and we thus obtain a direct clue to the magnitude of the unit which goes to form the starch molecule. When digested with methyl alcohol containing hydrogen chloride, the methylated polysaccharide was converted into trimethyl methylglucoside and dimethyl methylglucoside. These were separated by distillation in a high vacuum and thereafter hydrolysed to give the parent sugars. A totally unexpected result was encountered in that the trimethyl glucose isolated proved to be the crystalline form in which the methyl groups occupy the 2.3.6-positions. One glucose-residue in starch must thus be substituted as shown in Formula I., and must have the linkage characteristic of cellulose. In order to accommodate the formation of maltose from starch, either one or two additional glucose residues must be present at X and Y in the unit, but before developing a formula which will fulfil the above conditions, an outline of the reactions involved may be given:—



It will be seen that the removal of trimethyl glucose and dimethyl glucose in the molecular ratio of 1:2 is effected without alteration in the composition of any methylated starch which survives hydrolysis.

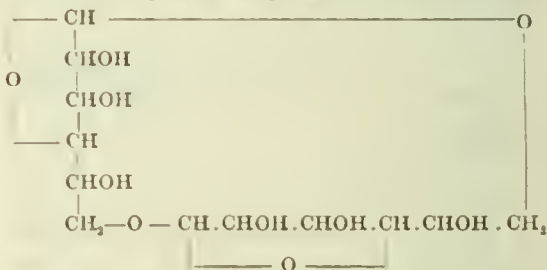
Four different structures may be built up to accommodate the formation of maltose and the results afforded by methylation. These possible formulæ differ in an important respect in that maltose may be obtained in two ways from one of the structures, and in only one way from each of the others. Pending the completion of further work on this subject, we prefer the Formula VIII. :—



The above constitution postulates that starch is derived entirely from the butylene-oxide form of glucose, and this we have shown experimentally to be the case.

Two objections to the molecular unit proposed may be discussed. In the formation of maltose no more than one molecule of this disaccharide could be obtained from one unit. The maximum yield of the sugar, without making allowance for any synthetical action of the enzyme, would therefore be of the order 70 per cent. (74 per cent. calculated as maltose hydrate). Another objection to the new structure is that the acetolysis of starch might result in molecular rupture in such a manner that cellobiose would be produced. So far, this disaccharide has not been encountered in the degradation products of starch, a result which is not surprising in view of the uncertainty attending the isolation of cellobiose.

It is perhaps advisable to point out that the experimental results now presented demand the rejection of various formulæ for starch proposed from time to time by Karrer. His structures are based on a diamylose (anhydro-maltose), two formulæ for which have been put forward, differing in the position of the anhydro-ring. The unit he prefers at present is:—



and it is clear that the only trimethyl glucose to which such a structure could give rise is the 2.3.5-form described by Irvine and Oldham. No trace of this compound was detected by us and, moreover, the 2.3.6-variety of trimethyl glucose actually obtained cannot possibly be accommodated by Karrer's formula. For similar reasons, it can no longer be maintained that starch is an aggregate of β-glucosan residues.

INULIN

(with Ettie S. Steele, G. McOwan, and M. I. Shannon)

Inulin is derived from fructose and, until recently, there was no reason to doubt that the parent hexose was the well-known levorotatory form of the ketose. This view is no longer tenable as, although inulin itself yields the normal form of fructose on hydrolysis, trimethyl inulin is converted into a *dextro-rotatory* trimethyl fructose. In similar manner, dimethyl inulin gives a *dextro-rotatory* dimethyl fructose. Each of these alkylated ketoses was proved to be a derivative of the γ-fructose which is a constituent of sucrose.

This result places inulin in a position which is unique, and the evidence is conclusive that the polysaccharide is entirely composed of γ -fructose residues, each of which retains three hydroxyl groups. One important point left unsettled in previous papers on this subject was whether the trimethyl γ -fructose obtained from trimethyl inulin is a single chemical substance or a mixture of isomerides. The experimental difficulties in the way are formidable, as methylated fructoses of the γ -type are liquids and give no crystalline derivatives. By the following method, however, it has been established that only one form of trimethyl fructose is produced from inulin.

Trimethyl inulin was digested with methyl alcohol containing hydrogen chloride under conditions which effected (a) depolymerisation, (b) hydrolysis, (c) condensation, to give trimethyl methylfructoside. The product was distilled in a high vacuum and fractions were abstracted at frequent intervals while the boiling point remained constant. All the fractions showed the same refractive index and specific rotation. Moreover, the speed of hydrolysis of the fructoside was in each case the same, and in each experiment the trimethyl fructose then formed showed identical physical constants. Of greater importance is the fact that all the specimens of trimethyl methylfructoside reacted in the same way when dissolved in acetone containing hydrogen chloride. Under these conditions, trimethyl fructosemonoacetone was formed, and here again the speed of the reaction showed no difference in any of the specimens.

There can be no doubt, therefore, that inulin is an aggregate of anhydro- γ -fructose residues and that each of the units is identical. As the exact structure of the methylated fructoses of the γ -type is not yet determined with certainty it is premature to speculate on the manner in which these residues are united, but the subject is engaging our attention.

* * *

Looking at the position which has been reached, it may be said that the polysaccharides, like many other fields of research, are after all not so complicated as they appeared when viewed from afar. The close relationship now established between cellulose and starch, starch and lactose, inulin and sucrose will, it is hoped, play a part in bringing within the range of exact experiment the structural study of all types of natural compounds related to the simple sugars.

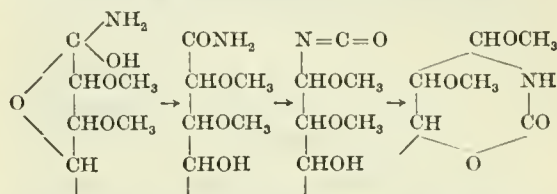
A New Type of Nitrogenous Sugar Derivative

By J. Pryde

In extending his studies of the action of sodium hypochlorite on amides of α -hydroxy acids, Weerman applied his reaction to the amides of simple hexonic acids and so devised what has proved to be the best practical method of degrading hexoses to pentoses. In the present communication the results

of applying this degradation method to a fully methylated hexose are given. The investigation was originally undertaken in the hope that a propylene-oxido form of a methylated arabinose would be obtained in place of the normal butylene-oxide type, or alternatively that the intermediate compounds would be isolated and thus elucidate the course of the reaction as applied to the sugar group.

Tetramethylglucose was oxidised to tetramethylgluconic acid, which was isolated as its internal lactone. The lactone, dissolved in absolute alcohol, was treated with dry ammonia and the amide was isolated in a crystalline condition. Evidence is available to show that this compound does not possess the structure of a true acid amide, but exists in the form of an aminolactone. On subjecting the amide to the action of cold alkaline hypochlorite a crystalline body of the composition of the intermediate isocyanate was obtained and from its behaviour the constitution of an internal urethane has been assigned to it. The reaction proceeds as follows:—



The formation of this intermediate urethane affords striking evidence of the stabilising effect of methyl groups in the sugar chain. It is also interesting in showing the conversion of a carbohydrate into a derivative in which nitrogen is present in a stable cyclic substituent.

The Preparation and Constitution of Synthetic Fats containing a Carbohydrate Chain

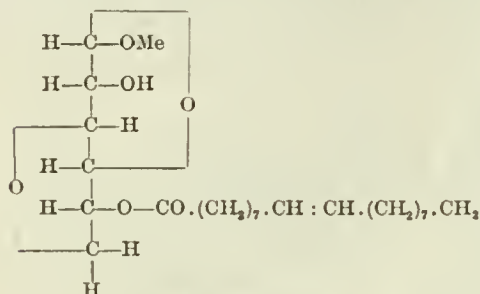
By Helen Simpson Gilchrist

The products obtained when a carbohydrate chain is coupled with the unsaturated groups characteristic of natural fats have been studied with the object of establishing the constitution of the synthetic fats thus formed.

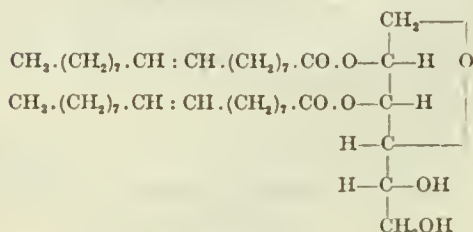
As shown by Lapworth and Pearson, α -methylglucoside and mannitol both combine, on heating in the presence of sodium ethoxide, with the oleyl residues of olive oil, thereby liberating glycerol. The present research has proved that a mono-oleate is initially formed in the first case, whilst in the second two oleyl groups enter the hexitol chain. This condensation is immediately followed by internal dehydration, the carbohydrate chain in each case losing one molecule of water, and the fatty residues remaining intact.

Anhydro-methylglucoside mono-oleate and mannan di-oleate are definite chemical individuals. On methylation they yield monomethyl derivatives, which are unstable in the high vacuum of the Gaede pump. On being heated with acid alcohol, these methylated compounds both give methyl oleate, together with an alkylated sugar derivative. In both cases the anhydro-ring in the molecule persists during hydrolysis and thus a passage is opened into the series of anhydro-sugar derivatives and alcohols.

Examination of the above cleavage products confirms the views already held regarding the mechanism of the reactions discussed, and complete structural formulæ are assigned to the original "methylglucoside" and "mannitol" fats.



"Methylglucoside Fat."



"Mannitol Fat."

THE SIGNIFICANCE OF CRYSTAL STRUCTURE*

SIR WILLIAM BRAGG

A CRYSTAL can be considered as built up by the repetition through space of a unit of pattern. The unit preserves throughout its internal character, its orientation, and its relations to neighbouring units. There is a minimum value for the volume of the unit, and its form is definite; but its boundaries may be chosen in different ways. For instance the smallest portion of a crystal of rock salt which fulfils the definition of a unit is a cube whose edge is 5.62 Angström units: and its corners may coincide either with chlorine atoms or with sodium atoms. We may call such a unit the "crystal unit."

The crystal unit contains every kind of atom or bond, every feature, and every property which the crystal possesses as a whole. If we investigate the physical properties of the crystal we investigate the physical properties of the unit. If we can discover the number and the arrangement of the atoms within the unit we may hope to discover also the part which each atom plays in forming the characteristics of the whole. The methods of X-ray analysis tell us very readily the number of atoms in the unit, and are throwing more and more light on their arrangement.

This mode of progress has its analogies in the history of physics and chemistry. Some

of the properties which substances possess are also possessed by the individual atoms or molecules of which they are composed. In the main the properties are those which are displayed when the substance is gaseous or liquid: when, in fact, its atoms or molecules are not linked together into crystalline form. Progress has followed on the discovery of the constitution of the smallest portion of the substance, molecule or even atom, which displays in full the properties referred to. As far as possible the part played by each atom in the molecule is then laid bare. The further this analysis is carried, the more does it become possible to carry out the reverse process, and to design, or it may be to construct, a substance having any desired characteristic.

The general limitation to the properties of gases or liquids is really severe. We remove it when, by the aid of X-ray analysis, we examine the structure of the crystal unit, because the unit displays all the properties of the solid. A crystal has elasticities, thermal expansions, thermal and electric conductivities, dielectric capacities, optical activities, and all these not only as scalars but as vectors. Quartz, to take a simple instance, has many properties as a crystal: all of them are displayed also by the crystal unit of quartz, that is by three molecules of SiO_2 arranged in a particular way. They are not characteristic of the separate molecule of SiO_2 , still less of the separate atoms of silicon or oxygen. When we know the exact arrangement of the nine atoms in the unit, we can apply all that we know about quartz to this small group. In this way a wide field of research opens out, in which the crystal unit plays a part like that of the molecule in other fields, and the magnitude of the results may be just as great.

So far as X-ray analysis of the crystal unit has progressed in the few years since its inception, it has followed the natural course. Some property of the whole substance is considered as capable of explanation by what is to be found within the unit. The first property to be treated in this way was that of form or symmetry, one of the most striking of crystal characteristics. In fact many of the first determinations of crystal structure were made by the aid of the principles of symmetry with a very little, but very necessary, assistance from the X-ray analysis. In the case of rock salt, for example, the symmetry is that of a cube, and of the highest class of cubic symmetry, so that, as soon as the analysis had assigned four molecules to the crystal unit, and had shown also certain differences in the spectra of the isomorphous substances NaCl and KCl , the structure was determined completely. Even with more complicated structures, considerations of symmetry are of great assistance, for they limit the number of possible configurations. Many instances are to be found already in the short history of X-ray analysis.

* An abstract of papers delivered before Sections A and B of the British Association, Hull, 1922.

When the symmetry of the crystal is considered as belonging also to the unit, and when at the same time the number of atoms or of molecules in the unit is known, very interesting deductions may be made concerning the symmetries of the atoms or molecules themselves. We may take a simple example from an organic crystal. Naphthalene belongs to the monoclinic prismatic class, that is to say, it has an axis of digonal symmetry and a plane of symmetry at right angles to it. There are two molecules in the unit. If the molecule had no symmetry of its own, the symmetry of the unit could not be achieved by the use of two molecules only; four would be required. We might imagine ourselves constructing the crystal with reference to a given axis and a given plane of reflection perpendicular thereto. We place one molecule in position, and a second so that it is the reflection of the first: then we turn the pair about the axis through 180° and so find the positions of the third and fourth molecules. Since only two molecules are required, not four, we conclude that the naphthalene molecule has already a degree of symmetry. If it has a plane or centre of symmetry, the latter of the two operations described is sufficient; the former, if it has a centre of symmetry, or a digonal axis. In mathematical terms, if the molecule has symmetry represented by $[(x, y, z), (x, -y, z)]$ i.e., a plane of reflection, the digonal rotation adds $[(-x, y, -z), (-x, -y, -z)]$; if it possesses a centre of symmetry as represented by $[(x, y, z), (-x, -y, -z)]$ or digonal symmetry $[(x, y, z), (-x, y, -z)]$, then reflection adds $[(x, -y, z), (-x, -y, -z)]$. The result is always the four-point symmetry of the monoclinic prismatic class, as already described.

It seems almost certain that we can go further than this and say that the naphthalene molecule has no more symmetry than is required for the construction of the unit: it has *either* a plane of symmetry, *or* a digonal axis, *or* a centre of symmetry and no more. Mr. Shearer, who has been investigating these questions, concludes that we can lay down, at least provisionally, the two following principles:—

(1) Any symmetry in the molecule itself is reproduced in the crystal.

(2) The number of molecules in the elementary lattice is always the minimum number necessary to give the full symmetry to the crystal.

It follows that the symmetry of the crystal can never be less and will in general be greater than the symmetry of the molecule.

The replacement of a hydrogen atom by a hydroxyl-group destroys all the symmetry of the naphthalene molecule: because the X-ray analysis shows that it takes four molecules to make the crystal unit of either α - or β -naphthol. On the other hand, acenaphthene has as much, though conceivably not the same, symmetry as naphthalene. There are four molecules in

the unit cell which is rhombic bipyramidal or, in other words, which can be obtained from a totally unsymmetrical molecule by reflecting across all three of a set of rectangular co-ordinate planes, as represented by $[(x, y, z), (x, y, -z), (x, -y, z), (-x, y, z), (x, -y, -z), (-x, y, -z), (-x, -y, z), (-x, -y, -z)]$, an eight-point system. The molecule of acenaphthene has, like that of naphthalene, a two-fold symmetry of some kind.

The crystal unit of benzene itself attains the same symmetry by the use of two molecules only: the molecule itself has a four-fold symmetry, it might be itself monoclinic prismatic in form, $[(x, y, z), (x, -y, z), (-x, y, -z), (-x, -y, -z)]$ or rhombic pyramidal $[(x, y, z), (x, y, -z), (-x, y, z), (-x, y, -z)]$. It has, in the crystal, no trigonal or hexagonal symmetry as might be suggested by the usual graphic formula.

Quartz has a sixfold symmetry which can be represented in cylindrical co-ordinates by $[(r, \theta, z), (r, \theta + \pi/6, -z), (r, \theta + \pi/3, z), (r, \theta + \pi/2, -z), (r, \theta + 2\pi/3, z), (r, \theta + 5\pi/6, -z)]$. Three molecules make up the crystal unit: and it is the threefold repetition of the molecule about the axis which introduces the 3 as a factor. Each molecule itself has digonal symmetry and no more: this symmetry is necessarily found in the crystal and gives the three digonal axes.

All these considerations are based on the principles of symmetry, which concern themselves with the *angular* dimensions of the crystal unit. With the examination of the *linear* dimension we enter another field of inquiry. The main lines were laid down by my son, W. L. Bragg, in a Friday Evening Discourse at the Royal Institution and subsequently in the Philosophical Magazine (August, 1920). It appears that to every atom may be assigned one or more radii of combination: so that when two atoms are neighbours in the construction of the crystal unit the distance apart of the centres is given by the sum of the two appropriate radii. An atom may possess more than one radius, according to the nature of the combination: but the number of such radii is so limited that the conception is most useful. In the case of the alkali halides, for example, each atom can be given a definite radius of combination, with consistent results. But if the nature of the combination is varied, so may be the radius. A simple example is that of calcium in the metal and calcium in calcium fluoride: it is necessary to assign a larger value to the radius of combination of calcium in the former case than in the latter.

Even the rule that, if an atom is surrounded by a number of like neighbours, it must be at the same distance from all of them, is sufficient at times to assist in the solution of a crystal structure. For example, in the case of ice, it is certain, *a priori*, that either an oxygen atom is surrounded by eight hydrogen atoms at equal distances from it, and a hydrogen atom by four oxygen atoms, or there is a six-

to-three arrangement, or a four-to-two: and it is quickly found that the last is the only solution possible. Consequently every oxygen atom is at the centre of gravity of its four oxygen neighbours, from each of which it is separated by a hydrogen atom. This defines the structure, except that there are two alternatives, corresponding to the two alternative forms of close packing, hexagonal and cubic. The former is usual in the case of ice, but apparently the latter has been observed.

Other properties of the crystal have also been examined: Born, Landé, and others have considered the elasticity of the crystal in reference to the unit, especially in the case of polar crystals, such as rock salt. Older measurements of the physical properties of crystals are applicable now that the structure of the unit can be examined: but the whole field is barely touched as yet. Backhurst, who has investigated the effect of temperature, up to 900° C., on the reflecting powers of crystals has obtained some very interesting results, incidentally, on their behaviour during expansion. A cubic crystal expands uniformly in all directions of course; but the examination of the expansion of the crystal unit in various directions must give important results. For example, Backhurst finds that the expansion of graphite along the axis is very great: whilst across the axis it is small, perhaps no more than in the case of diamond. In the sapphire the effect of temperature upon the intensities shows that the relative arrangement of the molecules changes: the two aluminium atoms keep apparently at the same distance, 2.7 A.U., from each other—they are in a sense in contact—whilst the other atoms move with respect to them. A very interesting line of research opens up in this way.

Very little, indeed, has been done with respect to optical properties. Astbury has been examining the structure of tartaric acid: he finds that there are two molecules in the unit cell, and as the latter possesses twofold symmetry only, the molecule has no symmetry at all, as might be expected.

When a model is constructed in accordance with the indications of the X-ray analysis, it shows two spirals in each molecule. One of them lies in the carbon atoms at the core of the molecule and might be expected to persist in solution. It implies an optical activity peculiar to the molecule. The other spiral lies in the hydroxyl groups: it is due to the crystalline structure, and would disappear in a dilute solution in which the molecules have become totally independent. Lowry has predicted the existence of two terms in the expression of the optical activity of tartaric acid; the X-ray analysis suggests their origin.

In this short account it has been possible to describe, no more than briefly, the beginnings of what we may hope will be a great development of scientific research.

THE CHEMIST'S PART IN THERAPEUTIC PROGRESS

SIR WILLIAM POPE

THE daily Press has lately given a good deal of attention to a new chemical material which is supposed to be an absolute specific in cases of sleeping sickness; this interest is well deserved, but it is not clear that sound views on the subject are being placed before the public. It appears that a substance described as "Baeyer 205" has been found more useful than any previously known as a cure for sleeping sickness (*cf. J.*, 1922, 218R); as it is very probable that many substances can be made which will effect this cure, no reason exists for doubting the justice of the claim.

So much importance is attached to the question that it has been thought necessary to send a deputation of German experts to British Central Africa to test the efficacy of their product and to prove its value. It is probable, and indeed greatly to be hoped, that they will succeed. The composition and method of manufacture of the substance are, of course, kept secret so that Germany may be enabled to sell it, at a profit, to the British Government. We are further informed by *The Times* of August 25 that the Baeyer works has provided material for use in the Belgian Congo against malaria and the various coast fevers. We are also told that at the meeting of the "Association of Tropical Diseases," held at Hamburg, the statement was made that "Baeyer 205" is the key to tropical Africa, and consequently to all the colonies, and that the German Government must "be required to safeguard this discovery for Germany; its value is such that any privilege of a share in it granted to other nations must be made conditional upon the restoration to Germany of her colonial empire."

It may be stated at once that no vast effort on the part of any scientific genius is required to produce a cure for sleeping sickness, or, indeed, of malaria, coast diseases, leprosy and many other maladies which make colonisation difficult. During centuries past a certain number of diseases have led to such extreme suffering and have proved so resistant to treatment that exaggerated views have been formed concerning the difficulty of finding a radical cure or an infallible preventive. The more mysterious is a disease in its nature and in its mode of attack, and the more horrible it proves in its effects, the more prone is the mind, by a simple psychological process, to attach difficulty to the problem of finding a cure or a prophylactic. Not many years ago one of the foremost of English physiologists remarked to me that he conceived two eventualities which would justify him in committing suicide: if he were suffering from cancer or from syphilis. He may retain his opinion with regard to cancer, a disease which we do not yet understand, but he has

certainly abandoned syphilis as a justification for desperation.

As a result of scientific work of the very highest order of excellence we now know the nature of syphilis; this disease is due to the presence of a minute organism, the *Spirochæta pallida*, in the blood stream, and kinematograph exhibitions have been given showing the organism at work. The nature of the disease once established no great scientific genius was required for the production of a cure; a comparatively simple routine method is available for discovering a cure for syphilis and for those many diseases of allied character—malaria, coast diseases, leprosy—which make colonisation difficult. This efficient method of attacking the problem has been applied by the Germans; it consists in studying the toxic effects of all likely chemical substances on the lower organisms which may cause disease by establishing themselves in the blood stream. Ehrlich found that substance numbered 606 is more toxic to the organism of syphilis than it is to its human host; substance 606 then at once took precedence of all other means of treatment and established itself as the first definite cure for syphilis. Similarly it was found that injections with trypan-blue cure piroplasmiasis or red-water, which had long been recognised as the scourge of all the great cattle-raising areas of the world. In the same way, if Baeyer 205 destroys the trypanosome before it kills the patient it will cure sleeping sickness.

If we have any faith in the methods of science and repose any confidence in the direct and logical conclusions drawn from experimental results we must believe that each disease of this particular parasitic class—syphilis, malaria, sleeping sickness, leprosy, etc.—can be cured by one application of some one of the myriads of chemical substances which can now be made. This being the case it seems shameful that this country, with its great overseas responsibilities, should be content to allow Germany, with no colonies, to carry out the simple programme of investigation which leads to the discovery of infallible curative agents for tropical diseases which are otherwise fatal.

The National Medical Research Council is well organised for studying the properties of any particular drug which may be brought to its notice, but something more than a medical or pharmacological organisation is needed for the efficient working-out of the problems presented. The Government requires a council of chemists capable of drawing up a programme of work involving the preparation of series of allied compounds which may be expected to be toxic towards the lower organisms productive of this particular large class of diseases; with means of promptly making these compounds, and with the facilities already in existence for studying their therapeutic action, our country would quickly take precedence of Germany in the discovery of curative methods, and would

make impossible the ridiculous claims recently put forward at the Hamburg meeting referred to above. The fact that an "Association of Tropical Medicine" exists in Germany, with the main objects of curing diseases which do not occur in German territory, and of drawing a commercial profit by treating those diseases in the territories of Britain and her Allies, is ample condemnation of our method of coping with tropical problems.

Clearly, what is required is the establishment of an advisory council of chemists to the Government to confer, to draw up a programme, and to see that it is carried out; the supply of the necessary research materials to the National Medical Research Council would thus be assured. As has often been pointed out before, such an advisory council would render inestimable service in connexion with the applications of chemical science and technology to many branches of national activity.

MEETINGS OF OTHER SOCIETIES

INSTITUTION OF RUBBER INDUSTRY

At the meeting held in the Engineers' Club, London, on September 4, Mr. F. Kaye read a paper on "Rubber Latex in Paper-Making."

Rubber latex is a limpid liquid which contains 30 to 35 per cent. of rubber and is miscible with water in all proportions. Ammonia is an efficient preservative, the cost being from 1½d. to 2d. per gallon of latex, and material thus preserved is selling in London at 4s. 3d. per gallon. The cost of breaking down the coagulated rubber used for compounding may be from £7 to £8 per ton, and this can be set against the increased freightage on rubber imported in the form of latex.

The method of using rubber latex in paper-making is comparatively simple, the essential condition being extensive dilution of the latex before addition to the beaten pulp, so that the latex quickly penetrates and becomes intimately associated with every particle of the beaten fibre. After thorough mixing with the pulp the rubber is thrown out on the fibre by suitable coagulative agents, such as magnesium sulphate or acetic acid. Alum is found, however, in most cases to be effective, used exactly as in ordinary paper-making processes. If the paper has to be tub-sized alum can be used as the coagulative agent, and if the paper is machine-sized the latex may be added before or after the size and alum, provided that sufficient alum is added to throw out the size and rubber completely.

Rubber latex has some specific effect upon the fibres in the beating engine and upon the rate of hydration of the fibres. Fibres in paper made with small or large amounts of rubber latex are often closer and more uniform in texture than a paper made of the same fibre without rubber latex. Paper can be considerably improved by adding such small amounts of latex as will give a rubber content of 0·1, 0·2, and 0·5 per cent., and vegetable, animal, and even mineral fibres, such as asbestos, may be used in paper containing rubber latex. New qualities of paper can be made, and if larger proportions

of rubber are introduced it will be quite possible to make leather substitutes and linoleum substitutes on a paper-making machine. Experiments show that all kinds of stock—paper, boards, leather and linoleum substitutes—can be dyed during the process of manufacture in the beating engine, as rubber in the latex form takes up the dye quite as freely as the fibre, so that a great variety of effects can be produced.

INSTITUTION OF CHEMICAL ENGINEERS

At the twelfth meeting of the Provisional Committee, held on August 2, Sir Arthur Duckham presiding, it was reported by the solicitor that the registration of the Institution by the Board of Trade was still delayed.

The suggestions of the Institute of Chemistry were agreed to, viz., that the definition of Chemical Engineering should be omitted, and that a clause should be inserted stating that the Institution claims no right to prescribe courses of study or to hold examinations whereby qualifications, or authority to practice or to use any distinctive title, can or may be conferred in respect of the practice as such of analytical or technical chemists (other than chemical engineers) or of teachers of chemistry.

The Committee was unanimously opposed to changing the title of the Institution.

A balance-sheet and revenue account were submitted by the hon. treasurer, showing a surplus balance of £225 6s. 8d.

The hon. secretary reported that over 100 completed application forms for membership had already been received. It was agreed that the question of membership must be held in abeyance until negotiations with the Board of Trade were completed, which it was hoped would be in about six weeks' time.

CORRESPONDENCE

PASTEUR COMMEMORATION FUND

SIR,—I have to inform you that a sum of £843 14s. 6d. has been subscribed to the above fund, and you will find appended a list of the subscribers. This amount is in addition to sums which had previously been sent to France in response to earlier and direct appeals.

In accordance with a resolution passed at a recent meeting of the Pasteur Commemoration Committee, presided over by Sir Charles Sherrington, a draft for the above amount is being forwarded to Monsieur Héring, the General Treasurer, with an intimation that should the amount prove more than the French Committee desires to expend upon the monument, the excess should be devoted to some other form of permanent memorial of Pasteur in the University of Strasbourg.

On behalf of the Committee, I desire to take this opportunity of thanking you for your assistance.—I am, Sir, etc.,

A. CHASTON CHAPMAN,
Treasurer and Secretary.

London.
August, 1922.

	£	s.	d.
Messrs. Ansells Brewery, Ltd.	50	0	0
J. L. Baker, Esq.	1	1	0
Messrs. Barclay, Perkins & Co., Ltd.	50	0	0
Prof. G. Barger	1	1	0
Messrs. T. & J. Bernard, Ltd.	5	5	0
Messrs. Boddingtons' Breweries, Ltd.	10	10	0
Messrs. Brickwood & Co., Ltd.	5	0	0
Lawrence Briant, Esq.	1	1	0
Dr. Horace T. Brown	2	2	0
Messrs. Campbell, Hope & King, Ltd.	3	3	0
A. Chaston Chapman, Esq.	8	3	0
Messrs. The Cheltenham Original Brewery Co., Ltd.	5	0	0
Messrs. The City of London Brewery Co., Ltd.	21	0	0
Messrs. Robert Deuchar, Ltd.	2	2	0
J. Doull, Esq.	1	1	0
H. E. Field, Esq.	2	2	0
J. S. Ford, Esq.	5	5	0
Prof. Percy Frankland	2	2	0
Messrs. Frilary, Holroyd & Healy's Breweries, Ltd.	5	5	0
Messrs. Georges & Co., Ltd.	10	10	0
Messrs. Groves & Whitnall, Ltd.	25	0	0
Messrs. A. Guinness, Son & Co., Ltd.	100	0	0
Messrs. Huggins & Co., Ltd.	5	5	0
Messrs. The Hull Brewery Co., Ltd.	25	0	0
Institute of Chemistry	10	10	0
Prof. A. H. Ling	2	2	0
Messrs. The Lion Brewery Co., Ltd.	10	10	0
Messrs. Mackie & Co., Ltd. (Laboratory Staff)	1	1	0
Messrs. Maun, Crossman & Paultin, Ltd.	50	0	0
Messrs. Marston, Thompson & Evershed, Ltd.	10	0	0
C. G. Matthews, Esq.	1	1	0
Messrs. Meux's Brewery Co., Ltd.	10	10	0
Dr. A. K. Miller	1	1	0
Messrs. Mitchells & Butlers, Ltd.	50	0	0
E. R. Moritz, Esq.	1	1	0
Messrs. J. & J. Morison	1	1	0
Messrs. The Northampton Brewery Co., Ltd.	10	0	0
Messrs. The North British Distillery Co., Ltd.	5	5	0
Prof. Sir William Pope	2	2	0
Prof. J. Ritchie	1	1	0
Sir E. Sharpey-Schafer	1	1	0
Messrs. R. D. Sharp, Ltd.	10	6	0
Prof. Sir Charles Sherrington	3	3	0
Messrs. H. & G. Simonds, Ltd.	25	0	0
A. Skinner, Esq.	1	1	0
Messrs. Smith Garrett & Co., Ltd.	5	0	0
Society of Chemical Industry	21	0	0
Messrs. Steel Coulson & Co., Ltd.	5	5	0
A. S. Stenhouse, Esq.	2	2	0
Messrs. Stretton's Derby Brewery Co., Ltd.	10	10	0
Messrs. The Tadcaster Tower Brewery Co., Ltd.	25	0	0
Messrs. Wm. Teacher & Sons, Ltd.	1	1	0
Messrs. Joshua Tetley & Son, Ltd.	25	0	0
Messrs. Truman, Hanbury, Buxton & Co., Ltd.	25	0	0
Messrs. Thos. Usher & Son, Ltd.	2	2	0
Prof. Sir James Walker	3	3	0
Messrs. Peter Walker & Son, Ltd.	25	0	0
Messrs. Watney, Combe, Reid & Co., Ltd.	50	0	0
Messrs. The Wenlock Brewery Co., Ltd.	10	0	0
Messrs. Whitbread & Co., Ltd.	50	0	0
Owen Wightman, Esq.	2	2	0
W. R. Wilson, Esq.	5	5	0
Sir E. Almroth Wright	5	0	0
Messrs. Robert Younger & Co., Ltd.	5	5	0
Messrs. Wm. Younger & Co., Ltd. (Abbey and Holyrood Breweries)	25	0	0
Brewing Staff—Abbey and Holyrood Breweries	2	2	0
Laboratory Staff—Abbey and Holyrood Breweries	2	2	0
Messrs. Youngs, Crawshaw & Youngs, Ltd.	2	2	0

£843 14 6

SCIENTIFIC INSTRUMENTS: THEIR CONSTRUCTION AND APPLICATION

SIR,—Science, in the minds of many, is a side issue in the business of life—something that real, live industry can very well get along without. To such the mention of a scientific instrument merely draws attention to something considered unessential to material prosperity and national expansion. For this reason I am sorry that the Institute of Physics has chosen such a title as "Journal of Scientific Instruments" for its proposed publication. I do not dispute the fact that its mission is to describe instruments that have been developed by scientific research and perfected by an appreciation of the value of scientific precision; but I believe that, although the publication of details will help science to make fresh discoveries, the main object of the new publication should be educative—so that the scope and uses of such instruments can be appreciated by industry.

It is mentioned, tentatively, in the prospectus that Dr. Leonard Hill is to describe the kathermometer in a forthcoming issue. Although its invention was a scientific achievement, I am interested in it chiefly because of its application as a valuable guide to atmospheric conditions underground. Another interesting instrument is an electrical CO₂-recorder, which dispenses with chemicals—an additional example of scientific research of considerable value to economical power-plant operation.

The new journal, I feel sure, will do better commercially if it conveys by its title some idea of the immense service it can be to industry.

A. W. ALLEN.

Berkeley, Cal.
July 11, 1922.

NEWS AND NOTES

FRANCE

Alcohol as Motor Fuel

The following is a summary of an article contributed to *La Dépêche* by Monsieur E. Barthe, president of the Wine Industry Association (Groupe Viticole), and also of the "Carburant National," a committee appointed by the Government to investigate the use of alcohol either in place of or admixed with petrol.

In France it is permitted to incorporate 10–15 per cent. of alcohol with petrol, and chemists have recently been concentrating their attention on such mixtures without, however, losing sight of the possibility of gradually increasing the production of alcohol so that it may eventually replace petrol to a very much larger extent. On mixing 90 parts by volume of petrol and 10 parts of industrial alcohol (95–96 vol. per cent.), the liquid invariably separates into two layers, owing to the 4–5 per cent. of water originally present in the alcohol; but if the alcohol be absolute, or nearly absolute (99.5 vol. per cent.) such separation does not occur. The problem therefore was to manufacture alcohol of this strength on an industrial scale. M. Lorette, an engineer, has succeeded in making it at a cost very little exceeding that of industrial alcohol by the simple process of dehydrating the vapour of aqueous alcohol with quicklime, instead of the liquid, as hitherto. No essential alteration of the distillation apparatus is necessary; it suffices to interpose a column containing lime between the plate distilling-column and the condenser. In this way alcohol of 99.8 per cent. by volume is obtained in a single distillation. Trials have been made on a large scale at the arsenal of Sevrans with improvised columns working intermittently, and 5000 litres of absolute alcohol has been produced with the consumption of about 21 kg. of quicklime, which is readily saleable after use. It has been proved that mixtures of the alcohol with petrol remain homogeneous at a very low temperature (–25° C.), and that the stability of the mixture is not affected by exposure to moisture. Motor trials made with the mixture at Sevrans, and by the Autobus Cie., have given very satisfactory results.

It will now be possible to make compulsory the addition of a proportion of alcohol to all imported petrol. During a debate in the Parliamentary

Commercial Committee, it was objected that since notable quantities of petrol are used for lighting purposes, it would be difficult to make compulsory the admixture of alcohol and lamp petrol; but M. Patart has shown conclusively that these two liquids mix in all proportions and that the mixtures burn well in stoves, lamps, etc. Thanks to the discovery described above, it is probable that the proposal of compulsory admixture of alcohol with petrol made by the Groupe Viticole will be approved and adopted.

UNITED STATES

Government Assistance to the Chemical Industry

The Chemical Division of the Bureau of Foreign and Domestic Commerce, organised by Secretary Hoover, came into being on August 1. Its object is to place at the disposal of American chemical manufacturers accurate and detailed information concerning foreign markets for their products. The Division is sub-divided into the following sections:—Chemicals, general organic and inorganic; dyes and coal-tar chemicals; pigments, paints and varnishes; fertilisers and fertiliser materials; botanical drugs, pharmaceutical and medicinal preparations; essential oils, perfumery, cosmetics, and toilet preparations; explosives and fireworks.

One of the first tasks will be to compile a list, to be called the Exporters' Index, of American firms interested in the development of foreign trade, which will serve as the basis for distributing information on trade opportunities and conditions in foreign markets. Another will be the appointment of advisory committees to promote co-operation among the several branches of the industry, including existing trade associations, and the Department of Commerce; and an important feature of the work will be the periodical publication of analyses of export and import statistics relating to chemical commodities.—(*U.S. Com. Rep.*, Aug. 14, 1922.)

CANADA

Industrial Notes

The Winchester Dye Co., Ltd., has been incorporated and is equipping a plant at Trenton, Ont. It expects to place colours on the market at an early date.

The Dominion Dyestuffs, Ltd., has erected a plant at Fergus, Ont., for the production of a line of ten or twelve standard colours including acid, direct and chrome dyes.

The Rocky Mountain Paint Co., Calgary, Alberta, will start the manufacture of paints and colours at an early date. The company controls vast deposits of mineral colour-bearing materials in the western area of the province.

The Firestone Tire and Rubber Co., Akron, Ohio, will soon commence the construction of a new plant at Hamilton, Ont., to be equipped for an initial capacity of 3500 tyres a day. It is proposed to have the factory ready for operation before the end of the year.

Two new paper and pulp companies have been incorporated in British Columbia: the Wigwam Pulp and Paper Co., Ltd., with a capital of \$5,000,000, and the Bloedel, Stewart and Welch Corporation, with a capital of \$1,000,000. Both companies will operate in the Province.

Operations will be commenced this season in the construction of the plant of the Peninsula Sugar Co., Ltd., at Petrolea, Ont. The refinery will have a capacity of 600 tons of beets a day. Lambton County is one of the best sugar-beet growing areas of the Province, and thus the new refinery will be situated in the centre of its raw material. The machinery will be electrically driven and of special design. The plant will cost nearly one million dollars.

Forests and Forest Products

The area of the Province of Quebec is now 450,337,761 acres or 703,653 sq. miles. The Crown controls 434,724,394 acres of which 44,500,000 acres are under licence for the cutting of timber. The total acreage in the Province capable of producing saw logs, pulpwood, etc. is 130,000,000, divided into the following five classes according to their tenure: (a) private forests, 6,000,000; (b) forests on lots under location ticket, 1,300,000; (c) forests leased or timber limits, 44,500,000; (d) township forest reserves, 200,000; (e) vacant lands, 78,000,000 acres.

The estimated wealth of the forests in terms of timber is as follows:—

Species.	Volume. Billion feet board measure.
White and red pine	30
Spruce, fir, hemlock and resinous trees, except cedar	125
Cedar (<i>arbor vitae</i>)	20
Pulp wood	100
Hard woods (deciduous trees)	35
Total	310

From 1867 to 1920 the forests, under licence, have yielded to the Provincial Treasury \$48,148,220.

Railway sleepers of creosoted fir from British Columbia have been tried upon the Indian railways and found to withstand attacks of fungi and ants. Last year over 8 million feet and this year, to date, over 7 million feet have been forwarded to India.

Mining and Metallurgy

The value of the mineral production of the Province of Quebec for 1921 amounted to \$15,522,988, as compared with \$28,392,939 in 1920. The past year shows a decline in value of \$12,869,951, or 45.3 per cent. The metallic products reached a total value of less than \$100,000, whereas in 1920 they represented \$483,888. In 1919 the value was \$1,014,088, and \$2,855,120 in 1918.

It is reported that an extensive deposit of iron ore, running 60 per cent. iron, has been discovered north of Hudson's Hope, near the boundary of Alberta, in British Columbia, west of Peace River. This district produces considerable amounts of high-grade coking coal.

A geological survey is being made this summer of the iron-ore deposits of British Columbia, special attention being given to the haematite ores of the Kootenays and the magnetite deposits of the coast. Analyses of the iron ores from the north shore of Lake Athabasca, near Crackingstone Point, show iron 49.5, sulphur 0.08, phosphorus 0.03, and silica 21 per cent. The Consolidated Mining and Smelting Co. has developed an electrolytic process for the production of pure iron from the pyrrhotite gangue of the Sullivan Mine.

Ten tons of iron ore from Sarita River district, Vancouver Island, have been tested and reported to be satisfactory.

A meeting was recently held in Toronto at which a number of metallurgists interested in iron production were present. The matters considered were chiefly plans for the encouragement and development of the iron-ore industry in Ontario, and particularly regarding the possibility of working out methods by which low-grade ores can be treated economically. Suggestions were made which are having the attention of the Ontario Government.

GERMANY

Society for Colloid Chemistry

A new society, to be called the "Kolloidchemische Gesellschaft" and to be devoted to pure and applied colloid chemistry, is to be inaugurated on September 15 at a special meeting in Leipzig. A large number of distinguished scientists and many industrial firms have agreed to become members, and at the meeting in question, following the transaction of business matters, some eighteen chemists and physicists will speak on the relations of colloid chemistry to other sciences and to industry. The programme, in fact, is so full that each speaker will be restricted to a maximum time-limit, which will be recorded by a special automatic (acoustical) time-keeper. A kinematograph film depicting "Snapshots of Colloidal Solutions" will be shown and explained by Prof. Siedentopf of Jena. Prof. Wo. Ostwald is acting as secretary *pro tem*.

Metallurgical Research

The economy of material necessitated by the sharp competition which has existed among makers of machinery during the last ten years, has led to the erection, both by large and small firms, of laboratories in which practically every property of a metal or alloy is tested prior to use, and which have become indispensable adjuncts to the works. Much of this work was promoted by the late Prof. Emil Heyn, who actively investigated the strength and behaviour of materials under various conditions. In these laboratories a great deal has been done to improve the technically valuable properties of those metals which are produced in Germany, and many new alloys have been prepared. Of late, non-ferrous metals have received most attention, and in particular such light alloys as "elektron," "duralumin," and "silumin," whose properties have been improved, and whose use is increasing.

Capital Increases in the German Chemical Industry

Already in 1920 the average share capital of German chemical companies had increased fourfold, and now the increase is about tenfold. Particularly noteworthy is the increased capitalisation of the companies forming the "Interessengemeinschaft," whose stock has only been "watered" to a small extent, much new capital having been invested in plant extensions. The falling off in the average dividend disbursements since the Peace is not only connected with increased capitalisation, but also with the high level of profits which was achieved before the war. The reports of the companies show that their position is not wholly indicated by the dividends. Especially is this seen when market quotations are examined with reference to concessions to shareholders. Where the dividends show most marked disproportion to the quotation, an explanation is found in some expectation of preferential treatment.

Efficiency of Labour in German Factories

From observations made at the Höchst Farbwerke the following table has been compiled showing the time taken to execute various industrial operations during recent years, the time required prior to 1914 being taken as 100:—

	1919	1920	1921	Jan.-Feb. 1922
Coopery and joinery ..	94	95	102	120
Turning ..	51	86	107	110
Forging ..	86	106.5	110.5	—
Filling containers with dyestuffs ..	—	—	85.8	93.7
Loading coal by hand ..	—	—	71.5	62.8
Loading coal by steam crane ..	70	79	79	91.7

The results of the investigation show the great influence exerted by the change from hourly to piece rates.

The Cellulose and Paper Industry

The cellulose and paper industry, which before the war made few profits, is stated to have improved its position during recent years. The average dividend has increased from 7.7 per cent. before the war to 21.6 per cent. in 1921, whilst the average capital in 1920-21 was less than double that in 1913-14. Each of the ten chief companies (upon the results of which the present figures are based) further increased its capital in 1921. The average share quotation has increased 31.2 per cent. above that of June 5, 1920, and 83.3 per cent. above the nominal value. The average amount written off increased from 0.61 million marks in 1913-14 to 4.42 mill. mk. in 1920-21. It is well-known that profits in this industry have been derived almost entirely from the home trade.

Fuel Production

The Government Statistical Bureau (Statistisches Reichsamt) gives the following figures of production for the year 1921 and the first six months of 1922 (exclusive of the Saar district):—

	1921	Jan.-June 1922
	Millions of metric tons	tons
Coal ..	136.21	66,647
Brown coal ..	122.99	65,938
Coke ..	27.92	14,366
Coal briquettes ..	5.689	2,567
Brown-coal briquettes ..	28.24	14,107

There was a considerable decline in production during June, 1922.

Coal Research

The Kaiser Wilhelm Institute for Coal Research completed its eighth year at the end of July. The work, both scientific and technical, done at the Institute is recorded in the five published volumes of the "Abhandlungen zur Kenntnis der Kohle," and in a sixth volume now in the press. On the scientific side the Institute has investigated the origin and chemical constitution of coal, and the mode of formation of the products of distillation. The chief result of the investigations is that, in the main, coal is not formed from vegetable cellulose but from lignin through humic acid, the cellulose generally disappearing through fermentation during the process of decay. The technical work has included the production of oils by low-temperature distillation of the fuel in a rotary furnace. Oils produced from coal, lignite and peat contain nearly all the substances occurring in mineral oils, such as benzene, lubricating and fuel oils. The tar contains up to 50 per cent. of higher phenols for which no use has yet been found, but last year a simple method of

separating them was discovered, viz., by distillation in superheated water at 225° C., the less soluble phenols separating out on cooling. It was also found that these phenols are converted almost quantitatively into a mixture of benzene and toluene by passing them with hydrogen through a tinned iron tube at 750° C.

Lime in German Chemical Industry, 1919-21

Since its enforced restriction during the war the production of lime and related products has increased very largely. The combined production of the firms constituting the "Deutscher Kalk-Bund" was as follows in 1920 and 1921:—

	1920	1921
	Metrie tons.	tons.
Quicklime ..	3,052,968	4,048,034
Calcined dolomite ..	144,264	142,081
Marl ..	623,750	693,780
Ground lime (crude) ..	134,434	115,578

The output of quicklime in 1921 was more than double that in 1919 (2,003,565 t.), but was much below the average pre-war figure of 6.5 million tons.

In the period 1919-21 the quantities of lime used by the chemical industries were 177,006 t. (9.0% of total) in 1919, 257,267 t. (8.5%) in 1920, and 258,555 t. (6.4%) in 1921. In the sugar industry the amounts consumed were 6066 t. (0.3% of total) in 1919, 8220 t. (0.3%) in 1920, and 8545 t. (0.2%) in 1921. After the building industry, the iron and steel industry is the largest user of limo. In 1919 it consumed 578,120 t. (29.3%), in 1920 676,859 t. (22.5%), and in 1921 876,815 t. (21.8%).

GENERAL

Vanadium Compounds in Medicine

Falling in the same group of the Periodic Law as arsenic, antimony and bismuth, it is not surprising that vanadium has frequently been tried in some form or other in medicine. The simple vanadates have been applied in anæmia, tuberculous infections and other chronic diseases with little or no success. Vanadic acid has, however, been recognised as an efficient antiseptic in skin affections. Compounds of vanadium, with vanadium directly linked to carbon, analogous to the valuable arsenic compounds, are unknown, but compounds in which vanadium is linked to carbon via oxygen atoms have recently acquired some prominence. In 1917 Pröscher, Seil and Stillians demonstrated the antisyphilitic action of vanadium on the rabbit and in man, and the experiments have borne further fruit in the hands of the French observers, Fournier, Levaditi and Schwartz. These workers, following up the beneficial effects observed by themselves in the treatment of syphilis in man with complex bismutho-tartrates, have now tried various compounds of vanadium, niobium and tantalum with successful results only in the case of vanadium. The complex tartaro-vanadates of sodium or potassium, when injected intravenously or subcutaneously into syphilitic rabbits, have effected permanent cures, and in man the results were sufficiently encouraging to justify further search for somewhat less toxic combinations.

Vanadylformates, salicylates and tartrates were described some years ago by Barbieri, and co-ordination compounds of vanadium and acetylacetone and benzoylacetone by Morgan and Ross, but their therapeutic action has not yet been recorded.

The Swiss Aluminium Industry

Before and even during the war the policy of the Swiss aluminium industry was to supply the German aluminium-working industries with raw aluminium, but the depreciation of the mark and the increase in home production during the war reduced exports to Germany from 5644·7 metric tons of aluminium in 1913 to 3542·4 t. in 1920 and 1646·1 t. in 1921. This compelled the Swiss aluminium industry to look for new markets, which were found in the United States and Japan. Thus in 1921, 3420·6 t. of aluminium to the value of 8,523,000 fr., found its way to the United States, and 894·1 t. valued at 2,075,000 fr. to Japan. Besides this, Switzerland's aluminium industry, which is concentrated in the hands of the Aluminium Industry Society, of Neuhausen (capital 42,000,000 fr.), has commenced to pay more attention to the home aluminium-working industries and to participate financially in these. During 1921 the Swiss aluminium rolling mills exported 1193·4 t. (valued at 5,402,000 fr.), half of which went to the United States, and one quarter to British India. There are also several factories of aluminium vessels and other goods, the export figures of which totalled nearly 5,000,000 fr. in 1921.

Output of Minerals and Metals in Italy, 1921

According to figures prepared by the Central Inspectorate of Mines, the output of minerals and metals in Italy in 1921 was as follows:—

Minerals:—	Metric tons	
	1921 Estimated output	1920 Actual output
Iron ore	274,000	389,676
Manganesic-iron ore	5,980	99
Manganese ore	4,700	36,158
Copper ore	22,700	14,456
Argentiferous copper	—	1,759
Lead, silver-lead and silver ore	26,509	46,729
Zinc ore	69,000	95,985
Lead-zinc ore	340	570
Lead-zinc-copper ore	500	1,043
Pyrites	448,000	321,589
Anthracite	21,000	28,462
Coal	90,400	123,460
Lignite	1,019,700	1,571,735
Bituminous schists	3,156	16,325
Peat	63,500	147,607
Mercury, metallic	1,676	1,401
Sulphur	313,400	296,099
Salt, rock	45,400	46,989
Salt, brine	45,300	22,626
Petroleum	4,780	4,937
Asphaltic and bituminous rock	91,800	109,642
Bitumen, crude	600	984
Ichthyol shale	1,100	800
Alunite	1,176	3,445
Bauxite	49,100	13,139
Leucite	9,900	8,200
Magnesium sulphate	350	1,200
Boric acid	2,490	1,719
Graphite	5,750	5,393
Marble	254,000	352,421
Calcium carbonate, powdered	6,500	8,500
Pumice	10,900	25,200
Talc and steatite	21,000	21,475
Barytes	13,500	15,380
Mineral colours	10,900	11,833
Quartz	31,000	63,480
Felspar	2,400	2,600
Kaolin	13,500	19,323
Magnesian earths	9,400	33,850
Refractory materials	42,000	54,627
Metals, etc.:—		
Iron	60,400	88,072
Steel	683,200	773,761
Alloys	15,400	20,881
Copper	100	635
Lead	11,500	15,947
Zinc	380	1,177
Antimony	40	166
Aluminium	740	1,233
Zinc white	286	1,362
Coke, metallurgical	50,000	95,727

—(G. Chim. Ind. ed App., May, 1922.)

Mineral Production of Mexico in 1921

Statistics published by the Department of Mines give the mineral production of Mexico in 1921 as follows:—

Gold	..	..	..	..	..	..	684,673·0
Silver	..	..	..	..	..	..	64,463,664·41
							Metric tons
Lead	..	..	..	..	..	..	66,313·3
Copper	..	..	..	..	..	..	15,228·1
Zinc	..	..	..	..	..	..	1,256·9
Mercury	..	..	..	..	..	..	46·2
Molybdenum	..	..	..	..	..	..	3·2
Graphite	..	..	..	..	..	..	2,911·1
Arsenic	..	..	..	..	..	..	785
Tin	..	..	..	..	..	..	0·5
Antimony	..	..	..	..	..	..	44·5
Tungsten	..	..	..	..	..	..	14·3
Manganese	..	..	..	..	..	..	558·8

—(U.S. Com. Rep., June 26, 1922.)

Vegetable-Oil Industry in Brazil

Mr. J. B. de M. Carvalho [a member of this Society] has recently been visiting the oil-mills in Northern Brazil on behalf of the Brazilian Government. In his report to the Minister of Agriculture, Mr. Carvalho recommends the establishment of an experimental station at Para, to serve the States of Amazonas, Maranhao and Piauby, and another in Bahia. In all these States vegetable-oil seeds are abundant. He recommends, further, that particular attention be given to the hard-shelled babassu nut, which contains an excellent drying oil, and on the batiputa, which yields an edible oil. Mr. Carvalho is now making a survey of the vegetable-oil resources of the Southern States of Brazil.—(Cotton Oil Press, 5, 11, 1922.)

Nauli "Gum," a New Oleo-Resin

A sample of this "gum," yielded by a large tree that grows plentifully in the Solomon Islands, was examined at the Imperial Institute and found to consist of pale yellow, sticky lumps of a fairly soft oleo-resin with a strong odour of aniseed. Its percentage composition was: moisture 2·5; volatile oil 10·4; resin 8·18; matter soluble in water (largely anisic acid; no gummy matter was present) 3·7; matter insoluble in alcohol (mineral and vegetable impurities) 1·6 per cent. The "gum" is thus an oleo-resin that yields about 10 per cent. of a pale-yellow volatile oil which is quite unlike commercial turpentine oils, and apparently contains a relatively small quantity of terpenes and about 34 per cent. of anethole. Although the oil would be valueless as a turpentine substitute, it might be utilised as a source of anethole or as a substitute for anise oil. It only possesses about half the flavouring power of star anise oil, and would therefore not realise more than half its price. After removing the volatile oil, the residual resin was found to resemble gum dammar in certain respects, and to be suitable for making varnishes for mixing with colours immiscible with ordinary varnish. Being insoluble in caustic alkali, the resin could not be used in soap or size manufacture; it would probably sell at the same price as ordinary rosin of the same colour. It is suggested that the best method of exploiting Nauli "gum" would be to distil it locally or in Australia, and to market the oil and resin separately.—(Bull. Imp. Inst., XIX, 4, 1921.)

PERSONALIA

Assistant-Professor K. N. Moss has been appointed to the chair of coal and metal mining in the University of Birmingham.

Prof. Lindet has been elected president of the Association des Chimistes de Sucrierie et de Distillerie de France et des Colonies.

Mr. Ernest A. Smith has resigned the secretaryship of the British Non-Ferrous Metals Research Association and accepted the appointment of research metallurgist to the Sheffield Smelting Co., Ltd.

The Salters' Institute of Industrial Chemistry has awarded fellowships for post-graduate study to Messrs. O. G. Harris, W. S. Martin, J. H. Oliver and W. Randerson, and has renewed the fellowship of Mr. F. Raymond Jones.

Dr. W. H. Nichols is to represent the chemical industry of the United States on a joint committee of the Society for the Promotion of Engineering Education and of the National Industrial Conference Board, which has been appointed to consider the problem of training in engineering.

The following appointments are announced from Germany:—Prof. R. O. Neumann has become director of the Institute of Hygiene of Hamburg University in succession to the late Prof. W. Dunbar; Dr. H. Lecher has succeeded Prof. Freudenberg in the chair of organic chemistry at Freiburg University; and Prof. Wilke has accepted the chair of technical organic chemistry in the Stuttgart Technical Hochschule vacated by Prof. Gutbier.

* * *

Prof. A. Smith, head of the chemistry department of Columbia University, has died in Edinburgh.

The death is reported of Armand Vivien, the author of numerous papers on problems of the sugar industry.

We record with regret the death, at Meran, of Prof. E. Noelting, a well-known worker in the sphere of dyestuff chemistry, and formerly director of the school of chemistry in Mülhausen.

The memorial tablet to the late Sir William Ramsay will be unveiled in Westminster Abbey on Friday, November 3, at noon, by H.R.H. the Prince of Wales, who is patron of the Ramsay Memorial Fund.

From Austria the deaths are announced of Dr. F. Kretschmer-Forstburg, formerly professor of chemistry in the University of Vienna, aged 80 years; and of Dr. Th. Panzer, professor of physiological chemistry in the veterinary Hochschule of Vienna, aged 50 years.

The following deaths are announced from Germany:—Dr. H. Rubens, director of the Physical Institute of Berlin; Prof. E. Bergmann, director of the Chemisch-Technische Reichsanstalt of Berlin; R. G. A. Loibl, technical director of the Ratibor sugar factory.

CORRIGENDUM.—In the issue for July 31, p. 312 R, col. i, three lines from the bottom, for "16 ounces of platinum metals" read "0.16 oz. of the platinum group of metals."

REPORTS

BRITISH EMPIRE PATENT CONFERENCE, 1922. *Report of the Conference held at the Patent Office, London, June, 1922. Pp. 28. H.M. Stationery Office, 1922. Price 1s.*

A committee of the recent Conference of Prime Ministers and Representatives of the United Kingdom, Dominions and India recommended that a conference of representatives of the Patent Offices of His Majesty's Dominions should be held in London to consider the practicability of instituting a system of granting patents which should be valid throughout the British Empire. This Report is the result of the recommendation.

The United Kingdom, Canada, Australia, New Zealand, South Africa and India were represented at the Conference and there was also present one representative for the several Colonies and Protectorates. No evidence was taken.

At least 46 separate applications for protection are at present necessary for obtaining monopoly throughout the Empire, at a cost of about £300. If patents or their equivalents are granted, they are taxed to an extent amounting, for the whole Empire, to about £1200 during their life.

This was considered unsatisfactory by the Conference and it was resolved that a British Empire patent would be desirable as a means of cheapening the cost and simplifying procedure, provided that the autonomy of the Dominions and India were preserved.

Of the schemes considered for putting the resolution into effect, that involving abolition of local Patent Offices and the establishment of an Imperial Patent Office was rejected owing to practical difficulties and the necessity for preserving the right of the inventor to obtain a local patent. Another scheme by which the same search into novelty should be made by each local Patent Office and the locally granted patent should be operative throughout the Empire, was also rejected as too costly. Nor was the proposal acceptable that searching should be conducted solely by the United Kingdom.

The scheme preferred provides for retention of the local Patent Offices and their systems of granting local patents, and the establishment of a Central Patent Office for examining applications and granting patents, which may extend to as many territories as the applicant may desire, the application being open to opposition. The search to be co-extensive with that made at present in the United Kingdom, the Dominions and India. The main advantage of the scheme would be that the applicant would have to make only one application.

The cost of establishing a Central Office forbade the recommendation, at present, of this scheme and it was agreed to advise the adoption of a provisional scheme by which the patent granted under existing conditions in the United Kingdom should be extended to any of the territories desired by the applicant on payment of a simple registration fee, but the grant in that territory to be subject to the local objections and to local opposition; nevertheless, the specification accepted in the United Kingdom should be held to be in conformity with local requirements as to sufficiency of description and claims. In the Colonies and Protectorates, where examination of applications is non-existent

or perfunctory, registration of the United Kingdom patent should follow as a matter of course.

The Conference further recommended that whether or not any scheme for a British Empire Patent be found practicable, steps should be taken to render patent legislation uniform throughout the Empire.

EXTRACTS FROM THE ANNUAL REPORT OF THE MINISTRY OF HEALTH FOR 1921-1922 AND ABSTRACT OF REPORTS OF PUBLIC ANALYSTS FOR THE YEAR 1921. SALE OF FOOD AND DRUGS ACTS. Pp. 16. H.M. Stationery Office, 1922. Price 1s. 6d.

The total number of samples purchased under the Acts in 1921 was 113,664; of these 7582 were reported against, showing a decrease from 7.1 per cent. in 1920 to 6.7 per cent. in 1921.

Of the above samples, 61,439 were samples of milk, of which 8.6 per cent. was adulterated or not up to standard. In London 678 samples of milk (5.1 per cent.) were reported against, 357 contained extraneous water, the remainder being chiefly samples deficient in fat; only 10 samples contained preservative (generally boric acid). Excluding London the proportion of adulterated samples was 9.6 per cent.

Out of 984 samples of ordinary cream, 315 contained preservative, and 86 out of 707 samples of preserved cream contained preservative (boric acid in all cases) in excess of the permitted amount, or otherwise failed to satisfy the Regulations. One informal sample of cream taken at Burnley contained 0.59 per cent. of boric acid and a later formal sample from the same source 0.36 per cent.

Over 10,000 samples of butter were examined and 245 were reported against; of these 129 contained foreign fats, generally in large proportions, and 96 contained an excess of water. In one case a fine of £40 was inflicted for the sale as butter of a mixture containing 25 per cent. of margarine; 31 out of 4296 samples of margarine were reported against, 21 of these containing water in excess of 16 per cent. Only 5 out of 3490 samples of lard were reported against, but 41 out of 692 samples of dripping or cooking fats were reported as adulterated; one sample of dripping contained 40 per cent. of cottonseed oil, and 15 per cent. of rice flour was present in a sample of chopped suet.

The adulteration of flour was again small; 507 samples of ordinary flour were examined, 16 contained persulphate "improver" and one was a self-raising flour; only 7 out of 806 samples of self-raising flour were reported against. Deficiency in available carbon dioxide was the chief defect in baking powders; 45 samples out of 1210 were condemned.

The presence of copper salts in preserved peas still persists; 73 out of 168 samples contained copper salts, and a fine of £20 was inflicted for spinach containing 6.8 grains per lb. of copper sulphate.

A sample of "raspberry syrup" examined consisted of sugar solution acidulated with phosphoric acid and coloured with coal-tar dye; a penalty of £5 was inflicted.

In Surrey large fines—in one case £30—were inflicted for the sale of effervescing solutions of sugar acidulated with phosphoric acid as "lemon squash" or "lemonade." Of 5500 samples of drugs examined, 6.7 per cent. was reported against.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for August 24, 31, and September 7)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS.	REFERENCE NUMBER
Australia	Crockery, glassware	204
"	Sodium acetate (tender for) ..	9320/E.D./C.P.
Bolivia	Glass, glassware, pottery ..	225/73/F.G./M.C.
Brazil	Paper	242
British East Africa ..	Oils, grease, soap, aluminium ware ..	205
British India	Antimony, brass, sheets of copper, lead and zinc ..	3701/8/T.G.
Bulgaria	Copper, brass (tender for) ..	8988/F.E./E.P.
Colombia	Dry colours	224
Denmark	Metals, crude rubber ..	220
"	Iron and steel, tinplate, black sheets ..	221
"	Tinplate, black plate ..	222
Dominican Republic ..	Drugs, perfumery ..	216
Finland	Tinplate, tinned sheet ..	210
France	Tinplate	16664/F.W./E.C.
Mexico	Glass, glassware, pottery ..	225/47/F.G./M.C.
Netherlands	Technical rubber goods ..	231
New Zealand	Copper wire	9405/E.D./E.P.
"	China, earthenware, glassware ..	218
"	Newsprint paper	9467/E.D.
Norway	Artificial leather	234
Poland	Edible oils, fats	255
Spain	Superphosphate of lime ..	6555/F.L./C.C.
Sweden	Essential oils, essences, food colours, caramel	239
"	Dyes, tanning extracts, heavy chemicals, drugs	256
Switzerland	Gum kauri, gum copal, steel, tinplate	259
United States	Steel	16559/F.W./E.C.
"	Glass, glassware	225/4/F.G./M.C./A.

TARIFF CUSTOMS EXCISE

Angola.—Particulars of the revised scale of export duties are given in the issue for September 7.

Barbados.—Amendments to the customs tariff affect potable, non-potable, and perfumed spirits.

Ceylon.—Cocaine or its derivatives may not be imported without a certificate that the drug is required solely for scientific or medicinal purposes and that the Government approves the importation of the quantity specified.

Dominica.—Kerosene oil of 110° fire test and under may not be imported.

Germany.—The importation, except under licence, is prohibited of cocoa and cocoa products. From September 3 the duties on goods exported under licence have been increased in general by 60 per cent., but in some cases by 30 per cent. only.

Iraq.—Schedules of import and export duties are given in the issue for August 24. Many of the duties on chemicals range from 11 to 20 per cent. *ad valorem*.

Italy.—The manufacturing tax on national sugar and the surtax on imported sugar have been increased from 245 to 300 lire per 100 kg. of sugar which yields over 94 per cent. on refining, and from 240 to 288 lire per 100 kg. on other sugar. Increased duties are to be levied on goods imported from countries which differentiate against Italian goods.

New Zealand.—The prohibition of the import and export of tungsten and its alloys, compounds, and ores has been revoked.

Peru.—The export duty on petroleum and its derivatives has been fixed at 3·50 soles per metric ton.

Poland.—Goods which may not be exported include sugar, bone manures, hides, mineral, sperm and cylinder oil, potassium salts, ores, minerals, scrap iron and steel, and cellulose.

South Africa.—Until June 30, 1923, the importation of sugar is prohibited, save under permit issued by the customs authorities. A law has been passed providing for the inspection and grading of coal produced in the Union and intended for export or for bunkering steamers.

Tunis.—The prohibition of the export of coal, coke, hides and skins has been withdrawn.

Yugoslavia.—The export duties on certain animal fats and oleaginous seeds have been increased, and new export duties have been applied to edible oils.

TRADE NOTES

FOREIGN

Alsatian Potash

The Commercial Secretary at Paris has forwarded to the Department of Overseas Trade an extract from the *Bulletin Quotidien de l'Agence Télégraphique Radio*, which states that a French delegation, headed by Monsieur Louis Mercier, vice-president of the "Comité des Forges," is now engaged at the Hague in an endeavour to re-establish the group formed by the producers of potash in Alsace and in Germany, which before the war possessed the world monopoly of this product.

Chemical Exports from the United States

The Chemical Division of the Bureau of Foreign and Domestic Commerce has issued an analysis of the exports of chemicals and allied products for the fiscal year ended June 30, 1922, based upon preliminary returns. The figures show a decline of over 50 per cent. in the value of the total export trade (\$100,518,943 compared with \$220,000,000 for 1920-21), but this does not signify a corresponding decline in quantity; there were important increases as well as marked decreases in exports of the more important chemicals. The following table gives approximate figures for the exports of certain chemical products in 1921-22, together with rough indications of the increases and decreases in quantity over the previous fiscal year:—

Material	Quantity 1,000's of Short Tons	Value \$	Gain or Loss in Quantity
Acetate of lime	13·80	587,174	+50%
Glycerin	1·81	508,807	+50%
Caustic soda	61·50	4,060,815	+20%
Borax	5·05	545,601	+150%
Sodium silicate	13·02	270,041	(small gain)
Copper sulphate	2·41	227,019	(small gain)
Bleaching powder	13·22	502,870	—30%
Soda ash	16·50	757,634	—71%

The expanded classification of chemical exports, which was initiated in January last, indicates important trade in several articles which were not previously mentioned separately; thus in the six months to June 30, 1922, there were exported (short tons): dextrin 3862, potassium dichromate 1858·4, aluminium sulphate 5993·1, ammonia and ammonium compounds (excluding ammonium sulphate) 1286·8, and boric acid 417·3.

The value of the foreign trade in coal-tar dyes, colours and stains, except lake colours, decreased from \$13,577,788 in the fiscal year 1921, to \$3,805,917 in 1922; and the exports of pigments, paints and varnishes decreased by about 50 per cent. to \$10,069,211, the decline being mainly due to the reduced exportation of white lead (8700 short tons in 1921, 4500 t. in 1922). During the first 6 months of 1922 there were exported 954·5 short tons of lithopone, 507·2 t. of bone black, and 5093·5 t. of carbon and lamp black. Exportation of medicinal and pharmaceutical preparations decreased in value during 1921-22 by nearly two-thirds to \$5,383,399. Among fertilisers, exports of ammonium sulphate rose by nearly 100 per cent. to 168,077 long tons, valued at \$8,720,775, but those of phosphate rock declined. Shipments of prepared fertilisers in the period Jan.-June, 1922, amounted to only 9204 long tons valued at \$469,366.

In 1921-22 exports of rosin from naval stores increased from 877,109 barrels to 1,403,921 barrels, but declined in value from more than \$10,000,000 to \$6,623,499; foreign shipments of turpentine increased slightly in quantity to 10,786,280 gallons (U.S.), but diminished in value by \$3,000,000.—(*U.S. Com. Rep.*, Aug. 14, 1922.)

BRITISH

British Guiana in 1921

The sugar crop amounted to 110,985 tons, which compares with 104,069 t., the average yield of the previous 10 years, and 108,270 t. of sugar was exported. Successful experiments on the production of motor fuel from waste molasses have been made, and a sugar company is preparing to manufacture power alcohol on an industrial scale; the Government is assisting the undertaking by exempting the industry temporarily from taxation. Cacao was grown on a smaller area (1176 acres), but the acreage under Para rubber remained unchanged; shortage of labour for tapping and the leaf disease are the main factors that prevent the area under Para rubber from extending. Coconuts are now grown on 26,321 acres and 15,648,646 nuts were used locally as food or for making oil and 2,760,000 nuts, 39 t. of copra and 15,934 gallons of coconut oil was exported. The cultivation of limes increased slightly and the Government factory continued to work. Exports of lime products included 439 cwt. of citrate of lime, 4175 galls. of lime-juice, and 544 galls. of essential oil of limes. The output of diamonds rose from 233,456 stones, weighing 39,362 carats, in 1920, to 507,200 stones, weighing 102,604 carats, in 1921.

Imports declined in value by £1,691,878 to £3,487,608, and exports by £2,718,508 to £3,424,490. Of the aggregate trade of the Colony, the United Kingdom took 52·82 per cent., Canada 24·22 per cent. and the United States 13·49 per cent. Prospects for British trade are promising.—(*Col. Rep.-Ann.*, No. 1123, 1922.)

REVIEWS

TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918. No. 5. MANUFACTURE OF SULPHURIC ACID BY THE CONTACT PROCESS. Pp. 128. *Ministry of Munitions and Department of Scientific and Industrial Research*. London: H.M. Stationery Office, 1921. Price 26s.

This volume, containing results of scientific and industrial value obtained in the national factories during the war, maintains the high standard of excellence established by the four previous publications. Indeed, it is no exaggeration to say that the volume will be regarded as a classic, to which works chemists and technicians will have frequent recourse, not only for operating details, but for information concerning chemical control, thermal values and efficiencies, methods of calculation, platinisation, recovery and purification of platinum from old contact mass, and other such valuable data. The Ministry and Mr. Maenab are to be congratulated on the signal success which has attended their efforts.

The book is divided into two sections. One deals with the Mannheim oleum plant, the distinctive feature of which is that conversion of the sulphur dioxide into trioxide is effected in two stages, viz., by using ferric oxide and platinum as the catalytic media; the other section is assigned to the Grillo oleum plant, where platinum alone serves as the catalyst. Three excellent appendices complete the book, the value of which is enhanced by the scale drawings, graphs, and other illustrations, several of which are unique.

The first section commences with a general outline and description of the Mannheim plant, and is followed by commendably clear descriptive details of the several parts constituting the integral unit. The whole gamut is traversed: nothing apparently is omitted. With equal lucidity and detail is indicated the operation of the various parts of this plant, and valuable notes are furnished (pp. 11—37) on the working and control of the plant and the experiments which have been conducted from time to time to determine the conditions calculated to promote greater uniformity and higher efficiencies at all stages of the operation. Section 2 follows much the same arrangement as the preceding section, although supplementary information is afforded in relation to the production of the magnesium-sulphate mass, chemical control, thermal values and efficiencies, etc. The completeness of the thermal data is significant, and adds materially to the outstanding merit and value of the book. Indeed, the methods used and the data afforded will doubtless serve as a guide for calculations of a cognate nature covering a wide range of chemical operations. An equally prominent feature of this section is to be found in the calculations involved in the design of the plant, etc. These are given in considerable detail and are invaluable from many points of view. They are typical of the meticulous care and attention to detail which characterised Quinan's design of chemical and explosives plants.

It is known that certain oleum installations, outside the Ministry's control, proved a woeful failure owing to imperfect design of the purification section, and to faulty preparation of the catalyst. These imperfections could hardly have arisen had

this volume been in the hands of those responsible for the design of the plants in question.

Very little further comment is called for, or indeed is possible within the limits of this review. It is noted that the name and characteristics of the pyrites ore are not given in connexion with the experiments cited relative to the working of pyrites lump burners. Manifestly they have an important bearing. Some well-known pyrites ores are notorious for the ease with which they decrepitate, a disability which contributes to the formation of clinker and, incidentally, to an abnormal sulphur-content of the burnt ore.

Experience suggests that the Herreshoff mechanical burner is peculiarly responsive to the slightest irregularities of feed and air-admission, the temperature of the beds fluctuating appreciably, unless the most constant conditions are maintained. The Wedge burner, which has a greater throughput, has been found to be free from some of these disabilities. It is unfortunate that mechanical sulphur-burners were not installed at one or other of the factories of the Ministry of Munitions, as it would have been interesting to contrast the results of the operation of, say, the Tromblee and Paul continuous, mechanical sulphur-burner with the results known to be obtained with the hand-operated sulphur-burners described on page 49.

The book is printed in clear type, and its cost places it within the reach of all. It is an eminently practical contribution, and in the phraseology of Bacon needs "to be chewed and digested"; in other words, it is essentially a work to be studied.

P. PARRISH.

IRON ORE (*Summary of Information as to the Present and Prospective Iron-ore Supplies of the World*). PART 1, UNITED KINGDOM (pp. 237, 6s.); PT. 2, BRITISH AFRICA (pp. 76, 3s.); PT. 3, BRITISH AMERICA (pp. 115, 3s. 6d.); PT. 4, BRITISH ASIA (pp. 65, 2s. 6d.); PT. 5, AUSTRALIA AND NEW ZEALAND (pp. 106, 4s.). *Imperial Mineral Resources Bureau*. London: H.M. Stationery Office, 1922.

The above five parts deal with the statistics, production and iron-ore resources of the British Empire. As is well known, the Imperial Mineral Resources Bureau has been issuing an important series of publications on the mineral industry of the British Empire and foreign countries, with statistics of production, during the war period, 1913-1919, when most official statistics were in abeyance. With regard to iron ore, the National Federation of Iron and Steel Manufacturers felt that something more was required, and they offered their assistance, both personal and financial, in order to enable the Bureau to produce a work not merely dealing with production but summarising the known and prospective iron-ore resources of the world. This information is particularly valuable to British ironmasters, as the British iron industry relies more than that of any other country, with the exception perhaps of Belgium, upon imported iron ores.

The work before us gives evidence of much care and painstaking research into the vast mass of information that exists scattered in many places upon the subject of iron-ore resources. Part 1 is naturally

little more than an abstract of the publication of the Geological Survey on British iron ores, but in addition it contains a number of important statistical tables showing production, imports, exports, domestic consumption, etc. of iron ore and of the chief products of iron and steel manufacture. The information upon which the other parts is based has been for the most part obtained from the geological survey departments of the respective countries, some of which, notably the Geological Survey of Canada, have long devoted much attention to economic questions. It is self-evident that anything like a review of the immense mass of detailed information collected in these five volumes is out of the question. It can only be said that they cover very fully the intended ground, and constitute as complete and accurate a survey of the iron-ore resources of the British Empire as it is possible to compile at the present day.

H. LOUIS.

FIRST REPORT OF THE ADHESIVES RESEARCH COMMITTEE. *Department of Scientific and Industrial Research.* Pp. 129. London: H. M. Stationery Office, 1922. Price 4s.

The Adhesives Research Committee was appointed by the Advisory Committee of the Privy Council for Scientific and Industrial Research in December, 1919, to continue the work of the Adhesives Committee of the Conjoint Board of Scientific Societies. The present report includes the unpublished work of the latter committee, thus making a comprehensive summary of the work done from 1918 to the end of 1921. Two appendices are added, viz.: (1) a descriptive bibliography of gelatin prepared and revised by Dr. T. Slater Price, and (2) an account of the recent work of Prof. J. W. McBain on the nature of soap solutions and gels. The volume may be very highly recommended to all interested in glue, gelatin and other nitrogenous adhesives. The work done, however, appears to be almost entirely connected with nitrogenous adhesives, and the title "Adhesives Research Committee" is somewhat incorrect and misleading. Starch adhesives, which for many purposes have entirely replaced glue, are not even mentioned. A few experiments on casein cements are recorded, and the possibility of utilising the proteins of castor bean as a substitute for casein has also been demonstrated.

The necessity for the work arose during the war owing to a threatened shortage of the raw materials necessary for the manufacture of glues and casein cements. Hence, at first, conservation of materials and more economical methods of manufacture were more important than purely scientific investigations. The early work of the Committee was therefore chiefly empirical and confined to (a) the differentiation of good and bad glues by mechanical tests, (b) an attempt to discover the substances (and their properties) which give glue its adhesive power, (c) the prevention of waste of raw material during manufacture, and (d) the investigation of the adhesive power of substances obtained from material other than bone, hide, or casein. Later on, empirical inquiry gave place to systematic scientific investigation. In dealing with the mechanical tests of glues, reference is made to Major Robertson's work described in the "Report

on the Materials of Construction used in Aircraft and Air Engines," published by H.M. Stationery Office at 21s. It is a pity that a detailed description of the test employed was not included in the present report.

It is unfortunate, but perhaps unavoidable, that a Research Committee should have to spend so much time rediscovering what is already known to many chemists who work upon glue or gelatin. Thus on page 16 five general conclusions of the investigations are stated. Four of these are already quite well understood, and could have been ascertained by inquiry, with the saving of much time and trouble. The fifth conclusion is that gelatin can be made from undecalcified ground bones of $\frac{3}{8}$ inch diameter at temperatures below 100° C. The reviewer studied this question more than ten years ago, and has an experimental plant with which he prepared a high-grade gelatin from undecalcified bones and brought the method to the notice of a large manufacturer. Of course, it may be desirable to restate the simple principles of manufacture, but it can hardly be necessary for a Research Committee to carry out experiments to rediscover such facts as the deterioration of glue solutions at high or even on prolonged heating at low temperatures.

Under "Classification of Glues" a useful summary of various known tests is given. To these is added an important new one, viz., the "diffusible-nitrogen test," which is fully described. It is shown that the tensile strength of a glue is roughly inversely proportional to its diffusible nitrogen content. Valuable work, though with negative results, has also been carried out in the determination of the "Hausmann numbers" of different types of glue. These numbers are the percentages of nitrogen existing as "amide," "lumin," "diamino," and "other" nitrogen. Similarly, the percentages of free amino-acids and phosphorus have been studied, but, like the Hausmann numbers, they appear to have but little relation to the tensile strength of a glue. The opinion is expressed that, as a general rule, a gelatin or glue which forms a poor gel is not a good adhesive. In the experience of the reviewer, this is only true when dealing with any particular type of glue, and even then only serves as a measure of efficiency of the processes. One of the difficult things to explain is that certain glues, which will not gel, still have excellent adhesive properties, unless hydrolysis has proceeded far enough to reduce their viscosity seriously. For some purposes glues with a low jelly-strength are actually preferred, provided that they possess what the report terms the "optimum viscosity" which is necessary for the particular class of material to be glued.

In carrying out the study of the formation of gelatin, the rate of extraction of gelatin from both bones and skin has been studied, and in the case of ossein reduced to a mathematical formula. The effects of the presence of acids or alkalis in the extraction fluid and of prolonged heating are also here described.

The last 77 pages of the report, dealing with the descriptive bibliography of gelatin and the bearing of the results obtained in recent investigations of soap solutions upon the structure of gels, are a valuable addition. Altogether the report may be regarded as the first volume of a much-needed treatise upon a hitherto neglected subject.

S. R. TROTMAN.

DISTILLATION PRINCIPLES AND PROCESSES. By DR. SYDNEY YOUNG AND COLLABORATORS. Pp. xiii. + 509. London: Macmillan and Company, 1922. Price 40s. net.

The general arrangement of the material in the first section of this book is satisfactorily consecutive, and, considered in conjunction with the literary style, it may be said that there are few technical books, published in this country, containing matter which may be read with such little effort.

Commencing with introductory notes, mainly dealing with general laboratory directions and descriptions of apparatus, the next chapter deals rather scantily with the boiling-points of pure liquids. Following this we have a discussion on the vapour pressure of mixed liquids, and the influence of chemical relationship, and molecular association, thereon. In this chapter (Chapter III), it is suggested that miscibility is a function of intermolecular attraction, so that the relationship suggested by D. Berthelot and by Galitzine holds good. If, however, we accept the supposition that the boiling-point of a pure substance is a function of the attraction between molecules, the above relationship imposes upon us the necessity of adopting the doctrine that the greater the difference in boiling-point between two liquids, the greater will be their tendency to yield a heterogeneous mixture. This point is brought to notice in view of the prominence accorded to the work of F. D. Brown, and to the use of this relationship as a basis for carrying out experimental investigations. Chapter IV deals with the boiling-points of homogeneous and heterogeneous liquid mixtures, the effect of pressure on the boiling-points, and the composition of azeotropic mixtures. A list of the boiling-points and composition of a very large number of azeotropic mixtures is also given.

The treatment of experimental determinations of the composition of liquid and corresponding vapour phases (Chapter V) is satisfactory. Concise descriptions are given of the apparatus and methods employed by F. D. Brown, Lehfeldt, Rosanoff, Zawidski, and others, together with notes on the errors likely to arise in work of this kind. It is questionable whether Linebarger's work should be dismissed without discussion. The subject is taken up from a "theoretical" standpoint in the following chapter, but the treatment appears to be inadequate.

In Chapter VII the author gives laboratory directions relating to fractional distillation.

After discussion of the composition of liquid and vapour phases (*cf. s.*), the theme passes on to the relations between the weight and composition, and between the boiling-points, of the residue and distillate (Chapters VIII and IX); whilst in the same connexion, an able and critical treatment of various types of still-heads comprises the following three chapters, followed by notes (Chapter XIII) on the continuous stills devised by Carveth and by Lord Rayleigh. Chapter XIV deals largely with results obtained with the Young and Thomas type of column.

A short general description of the plant necessary to effect distillation on the industrial scale, given in Chapter XV, forms an introduction to the specialised matter given in subsequent sections of the book.

On reading the four following chapters one feels that a subject has been reached to which all that

has preceded forms merely an introduction. Professor Young has treated the subject of fractional distillation as a method of quantitative analysis in such a manner that one cannot but make the suggestion that this section should be published *per se*.

Section I concludes with a brief consideration of processes involving sublimation.

The subsequent sections of the book, devoted to industrial processes, include the manufacture of acetone and n-butyl alcohol, ethyl alcohol, the petroleum industry, distillation of coal tar, glycerin, and essential oils.

It is rather difficult to criticise without bias any technical matter written from a standpoint diametrically opposed to that which has formed the basis of one's training. However, in reviewing these sections of Prof. Young's treatise, we must bear in mind to what extent this work will benefit the technologist and chemical engineer who may specialise in such processes. This country has never become famous for the efficiency of its distillation plant; and, on reading through the sections devoted to the industrial aspect of the subject, one cannot but feel that we have not yet got away from the empirical and rule-of-thumb methods which have characterised such processes. A slight all-round improvement occurred during the war, with the advent of technical chemists from abroad; and, therefore, it is unfortunate that the latter sections of the book under review do not in any way illustrate the application of the theoretical side of the subject to the successful design of plant.

J. BROWN.

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REVIEW

Vol. XLI]

SEPTEMBER 30, 1922

[No. 18

SODIUM SILICATE AS AN ADHESIVE

REX FURNESS

THE First Report of the Adhesives Research Committee (*cf. J.*, 1922, 379 r) has been criticised from many points of view in the technical Press; perhaps its most noteworthy omission is the consideration of commercial sodium silicate—"water glass"—as an adhesive, the advantages of which are becoming increasingly realised. In this country several firms are using upwards of a thousand tons of this adhesive yearly, whilst in the United States its use is even more favoured. Owing to shortage of animal and vegetable products during the war, silicate adhesives were used on a large scale in Germany, and their advantages have ensured continued use under post-war conditions.

Commercial sodium silicate possesses all the essential properties of an efficient adhesive, viz., (1) ease, suitability, flexibility, and general efficiency of application to the materials to be united; and (2) power of "setting" in a suitable manner and time, with the formation of a bond of desired strength.

(1) The physical characteristics of a sodium silicate solution can be predetermined by the manufacturer (*cf. i.*) so that it will penetrate into the surface pores or irregularities, whether these be of large or microscopic dimensions, of the materials to be united, without saturating or passing through such materials; in other words, its viscosity can be so adjusted that it is neither too thick nor too thin for a required purpose. The surface phenomena exhibited between silicate solutions and the various materials which may be united with its aid are not well understood, nor is the reason why a bond is formed at all (this applies to adhesives in general, since the precise physical or chemical property upon which adhesion depends is not definitely known); it must, therefore, suffice to state in this place that silicate solutions will "wet" the surfaces of such substances as paper and paper products, wood, and abrasive materials.

(2) The setting of a silicate adhesive may result from cooling, or from the evaporation or absorption of water, or from all these causes combined. A smaller abstraction of water is needed from concentrated silicate solutions than from many animal and vegetable glues, so that the speed of setting can be greatly increased, and with it the speed of the particular machine upon which the work is being effected. The bond is permanent and is not disturbed

by warmth, as in the case of certain adhesives. The bond strength is perhaps not so high as that of animal glue, but it is superior to that of most other adhesives, and, what is far more important, the minimum bond is greater than the tearing strength of the materials with which it is used.

ADVANTAGES OF SILICATE ADHESIVES

Silicate adhesives may be prepared with any desired viscosity and setting time, and their composition can be varied to enable articles made with their aid to withstand any particular conditions of temperature and humidity. These adhesives do not putrefy or decay, they are immune from any form of bacterial activity, and they repel vermin. They are fireproof, and although not absolutely resistant to water the materials manufactured with their aid are damp-proof. The fact that they are odourless is of especial importance in the manufacture of built-up paper-board and corrugated containers for food products.

Again, silicate adhesives are cheap, both relatively as to the quantity required for uniting materials and absolutely. These facts, taken in conjunction with the important point that they are perhaps the easiest to use, as they do not require the application of heat, and may thus be kept ready for immediate use, must be regarded as constituting very substantial claims.

Let us compare briefly some of the above-mentioned properties of silicate adhesives with those of animal and vegetable products. Animal glue, for instance, is liable to deteriorate if not kept dry. Its solutions must contain disinfectants in order to prevent mould growth, and they are by no means odourless. Batches of glue solution must be freshly made at frequent intervals; and this adhesive is much more troublesome to apply than silicate adhesives, which are almost always applied cold and in the state in which they are received from the manufacturers. The organic constitution of glue and other popular adhesives renders them combustible, putrescible, and attractive to vermin.

Casein adhesives are troublesome in use as compared with the always available silicate solution, and in addition casein glues must be used very soon after the solution has been made. Even the patented and special types have a hardening period of a few hours only,

and casein glues in general, like animal or gelatin glues, cannot be relied upon to afford constant and uniformly reproducible batches. Many influences have been traced which affect casein and render such irregularity inevitable. Silicate adhesives of a specified quality and composition can always be relied upon to give constant results, provided temperature, humidity of the workroom, and other variable factors are controlled. Starch and dextrin adhesives are relatively weak in bonding strength, and in spite of the numerous special and patented "modified" starch adhesives, they are troublesome to prepare for use.

SODIUM SILICATE SOLUTIONS

The large variety of silicate solutions has rendered possible their use in many manufactures. Thus, the built-up paper-board industry finds no better adhesive; the facing or lining of corrugated paper or board, the production of multi-ply veneer, the manufacture of "mandrel" paper articles for food containers, etc., the employment of silicate as a sealing agent for packages, cartons, etc., the binding of artificial or natural abrasives in the making of abrasive wheels, and so forth, may be cited as examples of the use of silicate adhesives.

It will be obvious that one definite adhesive solution cannot serve for more than a limited number of purposes. The great merit of silicate is that it can be made into a large number of solutions of varying viscosity, stickiness, etc., and the composition of the "silicate" itself (the word "silicate" covers a wide field in commerce) can be modified so as to confer almost any desired physical state upon its solutions. To gain an insight into the basis of this wide range of properties, some account must be given of the variations possible in the constitution of silicate glass itself, and of the inter-relations of its solutions.

SODIUM SILICATE AND ITS COLLOIDAL SOLUTIONS

Although the chemical compound Na_2SiO_3 , Aq. can be isolated as a crystalline solid, it has little or no interest to the manufacturer or user of sodium silicate, since in solution it possesses none of those physical properties upon which most of the applications of "silicate" depend. The sodium silicate of commerce may be said, broadly, to consist of a colloidal solution of silica in Na_2O , SiO_2 or $\text{Na}_2\text{O} \cdot 2\text{SiO}_2$ (or both). Although not extensively applied in industry, the yellow and green silicate "glasses" are well-known to the chemist—the colours being due to iron compounds in the ferric and ferrous state respectively. The ordinary "water glass" of commerce is obtained from these "glasses" by dissolving them in water, allowing the aluminous and ferrous impurities to settle out, and evaporating the solution.

The ratio of sodium oxide to silica in commercial silicate solutions is usually calculated

from percentage compositions, and is not expressed molecularly; it varies from about 1 : 1.5 to 1 : 4. Many changes occur as the proportion of alkali increases; the total possible solid content increases greatly, the solution becomes heavier, and the viscosity at a given specific gravity diminishes. To take the case of two silicate solutions in which the ratios are approximately 1 : 1.5 and 1 : 4, respectively. At a constant gravity, say about 70° Tw., the more alkaline silicate is a thin liquid, easily poured, whilst the product high in silica is jelly-like and stiff. Conversely, to obtain both silicate solutions in an approximately similar state of viscosity, the alkaline product must be concentrated to almost twice the above gravity.

At this commercial limiting concentration, there are differences in the physical properties of the two types of silicate solutions. The product high in silica is jelly-like, and can be moulded to some extent, but the highly alkaline silicate is a viscous and sticky liquid, which can be drawn into threads, and which easily absorbs water from the atmosphere, so that it "dries" badly in use.

Between these two chosen extremes of alkali-silica ratio lie the silicates of commerce, and it will be appreciated that all grades of viscosity, stickiness, setting time—dependent upon ease of "drying"—and total content of solids can be produced by altering the alkali-silica ratio, and working the gravity in correlation.

The facts may be summed up as follows: (1) When the specific gravity of the solution is kept constant, the viscosity and alkali content vary inversely; (2) if the viscosity be kept constant, the gravity and alkalinity vary directly.

Examples of solutions from large shipments may be quoted to illustrate this point:—

Gravity (°Tw.).	Ratio $\text{Na}_2\text{O} : \text{SiO}_2$.	Viscosity (at 20° C.).
(1) 85 ..	1 : 3.26 ..	21.9 C.G.S. units.
(2) 87.7 ..	1 : 3.16 ..	19.8 C.G.S. units.
(1) 71.6 ..	1 : 3.53 ..	3.1 C.G.S. units.
(2) 71.96 ..	1 : 3.43 ..	1.7 C.G.S. units.

Although the gravity is not quite constant in either of the two cases shown, it increases from (1) to (2) and should therefore, of itself, tend to increase the viscosity. Limits are, however, set to the indiscriminate extension of these variations. Thus, if the alkalinity of the solution be too high, a very slow-drying water absorbent silicate results; and there are other objections which will be discussed later.

Broadly speaking, the viscosity and stickiness of a silicate solution can be arranged by the producer so that it will fulfil all requirements from an adhesive standpoint and possess no disadvantageous qualities.

THE ALKALINITY OF SILICATE

Such an alkalinity as is represented by a 1 : 1.5 ratio would lead to discoloration of the paper or wood products with which silicate is chiefly used as an adhesive. Many paper-

board articles, *e.g.*, food containers, are covered with a facing paper or label printed in colours. Now many colours are affected by alkali and labels printed in such dyes or inks become discoloured after long contact with a package of which the material has been built up with the aid of silicate adhesives of high alkali content. Paper tubes, made from mechanical woodpulp stock are "stuck" in the course of making by means of silicate, and if this is too alkaline, a yellow colour develops at the overlap. Further discussion of the effects of alkali in highly alkaline silicate solutions is unnecessary, as it has been stated that the chief use of silicate as an adhesive is for paper and wood products, which are readily susceptible to alkali attack. It should, however, be pointed out that other factors influence staining, and that a thin "neutral" silicate will stain a white board more than a thick highly alkaline product, facility of surface absorption and penetration having to be considered.

No one realises the significance of alkali content more than the manufacturer of silicate; for this reason silicates are not made with a high alkali content, and if the user will employ the adhesive as sparingly as possible—which is not difficult, as silicate spreads easily—no staining need be feared.

Labels printed in alkali-destructible colours have been successfully pasted on to containers with the aid of silicate of low alkali content, the labels being reasonably thick and not spread too thickly with the adhesive. In general, however, dyes affected by alkali should not be used in labels or coloured outside wrappings which are to be affixed by means of silicate.

Excessive alkali in a silicate adhesive tends to make the material with which it is used somewhat hygroscopic, and to render it very "slow" on the machine, *e.g.*, in paper-board manufacture. An alkaline silicate can be made sticky enough to cause edges to adhere after a short contact. Hence a balance must be struck between the various desirable qualities; in this way only can an article be produced which is sufficiently viscous and sticky, which has a convenient drying and setting rate, and whose alkali content is as low as is consistent with the realisation of the other essentials.

APPLICATIONS OF SILICATE ADHESIVES

Built-up paper-board, box-board, container-board and the like are made by uniting several sheets of paper-stock, not in themselves thick or strong enough for use in making packages, food containers, etc. A four-ply board is a common article of manufacture, and is made by uniting two "inners" of cheap mechanical woodpulp stock or chip stock, with two "outers" of a suitably (resin) sized Manila or jute stock. The "inners" are, say, 23 to 30 "points" in thickness—a "point" represents

a thousandth of an inch—whilst the "outers," range from 4 to 8 "points" in thickness. Silicate is applied by suitable spreading rollers to the "inners" only, the machine positions the "outers," and the potential board passes to pressure rollers, where the union is completed. A good adhesive has dried at this stage, so that the completed board can pass on immediately to the cutters and trimmers. The edges of the board do not become loose, and the loss by cutting and trimming is only a few per cent. even with the machine running at, say, 100 ft. per minute. A consumption of 35-40 lb. of silicate per 1000 sq. ft. of board made is a normal usage.

Several factors influence the efficiency of the machine, and of these temperature, humidity and quality of stock may be noted. In some factories the temperature is kept uniform by artificial means. It is obviously possible to use heated silicate adhesive, so that after application to the stock, the union takes place both by cooling—the silicate becoming more viscous—and by increased evaporation of the water. The stock should absorb the silicate as uniformly as possible, for if the "inners" are relatively more porous, it will be necessary to overload them in order to leave enough adhesive to make the bond with the uncoated "outers."

The production of wall-board, book-bindings, cloth-board, and in fact all kinds of built-up products made of wood or paper stock, requires no elaborate consideration, but it may be noted that mandrel-made articles—spiral or lap wound—are produced with silicate adhesives. The making of cylinders from plane sheets of strong board—the cylinders afterwards being cut into suitable sizes for food containers—presents difficulties which can be overcome. Thus, the "spring" of the board demands that a good "hold" at the overlap be quickly attained, otherwise the rate of manufacture is lowered. The alkali content of the adhesive must be watched, so that staining of the board shall not result, and, as above noted, the balance is struck between the various essentials.

Corrugated or crimped paper or board is often made into a three- or five-ply product. Thus, the latter consists of two corrugated sheets with a central, an outer and an inner liner or facing of suitable paper. This is affixed by smearing the tips of the ridges with silicate and pressing the liners upon them. The same qualities in the adhesive are again demanded, and the output of the machines is regulated by the speed of drying, the completion of the bond, etc. Silicates with 8.8 to 9.3 per cent. of sodium oxide and 28-29 per cent. of silica (76-81° Tw.), are found suitable but a compound with as much as 11 per cent. of sodium oxide has been tried; such silicates, however, are not as yet in general use.

The adhesives used in the production of built-up wood-board—veneers—are casein, alkali-

ine starch, glue, etc., but silicate is finding increased application. A thinner silicate can be employed, since pressure is applied for some time after building up the composite product. A silicate of about 55° Tw., with a relatively low alkali content, is preferable. "Fillers" may be added.

As a final example, the bonding of natural or artificial abrasives for the manufacture of abrasive wheels may be indicated. A mixture of abrasive, clay, and silicate is moulded and subsequently baked. A strong bond is formed, possibly by interaction between the alkaline silicate and the aluminium hydrosilicate of the clay. Occasionally there is interaction between the alkaline silicate and a silicon carbide abrasive employed, but the addition of potassium permanganate, which reacts with the hydrogen otherwise evolved, has been claimed to prevent imperfections caused by liberated gas. Silicate adhesive is largely employed in abrasive-wheel manufacture, but dry silicate "glass" is perhaps more suitable than the solution, the "glass" being employed in the dry process of wheel construction.

FILLERS

Whiting, dry (but not baked) clay, etc. may be added to increase the viscosity of the adhesive. If a thicker and more quickly setting adhesive be required, the filler is added alone, up to an equal weight. If a thicker adhesive with no increased setting speed be demanded, dilution with water may be practised, whilst the addition of both filler and water in larger amount will provide a thicker adhesive with a diminished setting speed. The action and relations of silicate and various fillers require further study, and this field of research appears to offer great possibilities. Such problems as the increased difficulty of application, the less "handy" type of adhesive which is necessarily produced, the requirement of agitation devices for the adhesive trough at the machines, must be investigated before "filled" silicates can be employed to supplant plain silicate solutions. They are, however, finding increased application, for example, in uniting very porous materials or surfaces of unequal porosity.

CONCLUSIONS

Sodium silicate solutions can be prepared to meet all the requirements of a good adhesive; they are superior to animal and vegetable adhesives in that they are fire-resisting, do not become rancid, and are vermin-repellent. Silicate adhesives are quite odourless, and produce damp-proof articles, they have a relatively high bond strength, and their setting times can be varied over a wide range. They are ever-ready, requiring no heat before or during application, and they give consistent results. The apparatus required for their application to wood, paper, etc. is extremely simple.

TECHNICAL ASPECTS OF HYDROGENATION*

THE technical application of what would appear to be a comparatively simple catalytic reaction—if any catalytic reaction may be considered simple—has inspired the subject matter of some 300 patents. All of these have for their aim the production of substantially the same product by reaching the same chemical end-point.

Our sympathy must be given to any unfortunate investigator, who, desiring to take up the study of the subject at this stage, is faced with contradictory statements and complications out of all proportion in magnitude to the simple manipulation necessary to effect hydrogenation on a commercial scale. I would that I could lay before you some sound scheme for the reconstruction of Patent Law, as applied to chemical products, framed in such a way as to frustrate the registration of so many patents on the one subject, without in any way doing an injustice to the genuine research worker and without producing stagnation of enterprise. Let those who have a ready solution of this problem read the able words of Horatio Ballantyne† so that they may first learn where angels fear to tread.

Hydrogenation has two main effects—(1) To produce a hard solid fat from a liquid oil; (2) To remove certain impurities which are not removable by any other means, so rendering the oil of use for purposes for which it could not otherwise be adapted.

Passing over theoretical considerations, the process may be briefly described as the introduction of a comparatively small weight of hydrogen into the oil (only a few pounds per ton). This small weight of hydrogen, however, occupies as much as 1 cb. ft. per lb. of oil treated, and it is this comparatively great volume of hydrogen which raises the first difficulty on the commercial scale and brings before the manufacturer the necessity for making the first decision—namely, shall operations be conducted near a convenient supply of hydrogen or near the source of the oil?

The production of cheap hydrogen, free from carbon monoxide and oxygen and having as little nitrogen as possible, has grown with the hardening industry.

The most important methods of producing hydrogen are—(1) By electrolysis; or (2) By decomposition of water by alternate oxidation and reduction of iron with producer gas.

Of the electrolytic methods there are—(a) Direct electrolysis of water, in which operation oxygen is a valuable by-product; or (b) electrolysis of salt, having for its main issue the production of caustic soda with chlorine as a by-product.

* A paper read by Mr. E. Richards Bolton to Section B (Chemistry) of the British Association, Hull, 1922.

† Lecture on "Chemists and the Patent Laws" published by the Institute of Chemistry, 1922 (cf. J., 1922, 121 n).

In both these cases hydrogen is directly obtained from water. Many other methods have been employed—such as the utilisation of the hydrogen of hydrocarbons and so forth. Of the possibilities of the future one must consider *hydrogen carriers*, where advantage is taken of the affinity of oil for hydrogen, in that oil, under the stimulus of the catalyst, can rob other compounds of their hydrogen; but whether a liquid, easily obtainable at a competitive price, can be found ready to give up its hydrogen to oil is one of the fascinating possibilities of the future, and one which might cause a readjustment of the whole hydrogen position.

In countries like Norway—providentially provided with water-power—production by electrolysis must, in the present state of our knowledge, hold the field; and it is only recent improvements that have allowed hydrogen, produced by other methods, to compete with the electrolytic product so as to permit the process of hardening to be carried out in a locality suitable to the oil supply.

I pass over the production of hydrogen thus lightly, not from want of realisation of its importance, but rather to emphasise what has always received the least attention—namely, the *oil* itself. One reads of hydrogen poisons, of catalyst poisons, and of the extraordinary care taken in the preparation of products to free them from these poisons. One finds works where all this care is taken and yet a perfect catalyst together with the most ideally pure hydrogen is introduced into oil, which oil has received quite inadequate attention and is reeking with impurities many of which are easily removable.

I have always held the view that the economy and efficiency of the process lie in a careful attention to the purity of the oil, and I feel that workers have been led astray by the fact that hydrogenation purifies so effectively that very little treatment is necessary to begin with. For this reason they have let slip from their observation the fact that most impurities, easily removable before hydrogenation, if left in the oil are merely wasters of catalyst and spoilers of hydrogen, and that impurities, more economically removed by simple means, are being dealt with in a more costly manner at the expense of catalyst and hydrogen. If I may for a moment poach on the field of theory, I would aim at the mark arrived at from theoretical considerations—namely, that, given a chemically pure oil and chemically pure hydrogen and catalyst, then, under these hypothetical conditions, the catalyst should retain its activity for ever, and, while such a state of affairs is obviously impossible, it is surely sound policy to approach it as nearly as practicable.

Now, to pass on to the catalyst, the working of which has been so often explained and is still so little understood.

With a few exceptions nickel is the catalyst universally employed. Among the exceptions are platinum and palladium, which, whilst almost prohibitive in price and involving very refined methods of recovery, cannot hope to compete with nickel in spite of the small quantity which is necessary, unless it can be shown that their activity at low temperatures—in fact appreciable activity at room temperature—confers some benefit on the finished product, not otherwise obtainable, for example, the hardening of particular oils without the destruction of vitamins. Otherwise, unless these metals fall very considerably in price, nickel has the field to itself.

The catalyst problem consists of three parts—(1) The preparation of a suitable catalyst; (2) the maintenance of its catalytic activity for as long a period as possible; (3) the recovery and reactivation of spent catalyst.

For the preparation of the catalyst the methods are many, but those commonly employed are based on the preparation of nickel carbonate precipitated on a vehicle, such as kieselguhr, and, after drying, reduced in hydrogen either directly in powder form or actually in the oil. The oil-reduction method produces a very active catalyst of a colloidal nature, a nature which, as one might expect, renders it more susceptible to poisons, and, in common with colloids, liable to sudden coagulation. In fact cases have come to my notice in which a nickel catalyst has suddenly coagulated from oil, in quite large particles as big as lead shot, and sunk, leaving a clear oil. (Research in this direction might be recommended to the colloid chemist, for whom, incidentally, there is a large field in connexion with oils generally.)

Notwithstanding such occasional irregularities, I have visited works where the catalyst is prepared on this principle with the most excellent results.

The simplicity of the dry-reduction method doubtless explains its great popularity. When this method first came into use a diversity of results was obtained, which was due to lack of temperature control and uneven heating. The more consistent results now so generally obtained are due to a clear appreciation of the following facts—namely, that:—

Low temperature of reduction (250°C.) increases activity but renders the catalyst more susceptible to poisons; whereas high temperature of reduction (350°C.) lowers the activity of the catalyst but increases its life.

Catalysts may well be compared to horses: the low-temperature product is swift as a race-horse, and the high-temperature product is steady and slow as a cart horse. The first gets there more quickly, no doubt, but the canny manufacturer who has to drag a thousand tons a week through his factory will choose the Clydesdale every time.

Having chosen the method of preparing our catalyst the maintenance of its activity must receive very careful attention, for therein lies one of the great sources of profit or loss in the process.

I began by emphasising the great need of purifying the oil, and I would ask those who take so much laudable care in purifying hydrogen and catalyst to remember that as little impurity as 0.2 per cent. in the oil represents one-fifth of the weight of 1 per cent. of catalyst, and, should the impurity be one which forms a film on the catalyst, the result is obvious; whereas, if the impurity be moisture, hydrolysis will result and the fatty acid produced will tend to form a coating of metallic soap.

All workers know how often a failure to hydrogenate effectually is associated with a rise of acidity. Hydrogenation is essentially a problem for those experienced in the properties of oil rather than for metallurgists and gas chemists.

The greatest solicitude that science can pay to the catalyst does not prevent the havoc of age, and, sooner or later, the time comes when the question of recovery and re-activation arises. In the early days the process of hydrogenation was so profitable that residues consisting of approximately 1 part of nickel, 1 part of kieselguhr and 2 parts of oil were discarded. The proportion of oil was subsequently somewhat reduced, but ere long recovery of nickel became essential to economic working.

Attempts to extract the oil by solvents from press residues have met with partial success, though, owing to the extreme fineness of the nickel, this is attended with some difficulty. A simpler method is to roast the residues or boil them out with caustic soda and roast the settled sludge. In some cases it may be sufficient to pass air over the ignited mass in a roaster, and, after displacing the air by CO_2 , reduce at $250^\circ\text{--}300^\circ\text{C.}$ by hydrogen. A catalyst recovered in this way does not regain its original activity, so that when working with fish and other low-grade oils the ignited nickel residue is dissolved in acid, preferably nitric acid, and re-precipitated. In the latter case it is important not to introduce impurities by the solution of other metals contained as impurities in the kieselguhr.

Processes have recently been suggested whereby both the oil and the nickel are recovered from residues in a condition suitable for immediate re-use, and these will, no doubt, come into general use in the future. The successful operation of such processes really means that the catalyst becomes a capital charge, in fact, a part of the plant, and such a revolutionary change is likely to lead to a complete alteration in the whole procedure of hydrogenation.

A most extraordinary amount of engineering skill has been directed to the designing of all

kinds of mechanical devices aimed at violent agitation and intimate admixture. The advancement of the art, however, is in no way commensurate with the skill and energy expended. The engineers—to use an Americanism—have been “barking up the wrong tree” when they have aimed at such violent methods; whereas, to the simple-minded, who have not been led into mystic paths of theory, it seems obvious that once the catalyst has become impregnated with oil, hydrogen can only reach it by penetrating through the oil—and to get through the oil, it must be in solution in the oil.

Once this is clearly understood it is easy to explain why such excellent results are obtainable with a gentle circulation of hydrogen-saturated oil. All that is really necessary is to remove the hardened oil from the surface of the catalyst in order to make access to fresh material.

The main types of plant devised may be briefly summarised under three headings:—

(1) A vessel nearly full of oil containing catalyst in suspension, through which hydrogen is circulated by mechanical means; possibly also with circulation of oil to maintain suspension of catalyst;

(2) A vessel full of hydrogen into which an intimate mixture of oil and catalyst is sprayed;

(3) Vessels containing stationary catalyst, through which oil and hydrogen are circulated.

Each of these three methods has fallen in for its share of elaboration, and it is unfortunate that, sometimes, the aim seems more the securing of a patent at any price than any real improvement of the processes.

After considering all these complications and elaborate devices it seems absurd to find that the very simple method which I use in my laboratory for testing samples of oil as to their suitability for hydrogenation, should achieve the same result just as well.

Activated nickel wire is lightly pressed into a test-tube and covered with the oil to be treated. A slow stream of hydrogen is bubbled through the oil, the test-tube and its contents being maintained at 180°C. Hydrogenation then takes place evenly, and the operation may be continued in this simple apparatus until the iodine value of the oil is reduced to nothing. The oil is poured away from the catalyst and is clear without filtration.

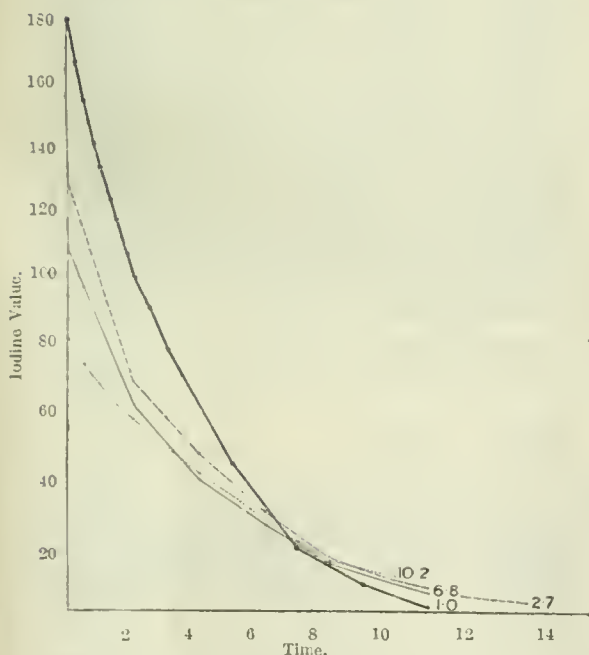
Practical experiments have proved to me that this laboratory method can be extended in its simplicity to a works scale.

It has been suggested that poisoning of a catalyst by sulphur obtained from impure oils is proportional to the mass of catalyst, whilst hydrogenation is a function of surface only. This suggestion has received experimental support in the work of Dr. Maxted on the

action of sulphuretted hydrogen on palladium.* This being so it would be expected that a catalyst with relatively large mass in proportion to its surface would hydrogenate oils containing small quantities of poisons almost independently of these poisons—that is, as shown by Dr. E. F. Armstrong, the velocity-time curve would be a straight line.

I have here some curves to show the results of hydrogenating oils by means of nickel wool which lend some support to this view. Though when we consider, for example in the case of linseed oil, the different chemical substances present—triglycerides of highly unsaturated fatty acids with three double linkages, hydrogenated down to olein and finally to pure tristearin—the fact that no break is shown in the curve may mean that the physical factors of contact, etc., are overwhelming the chemical side of the reaction altogether.

Linseed Oil —————
Soya Bean Oil - - - - -
Cotton Oil - - - - -
Olive Oil



In conclusion, it is pleasant to think that the ideal at which we should aim—namely, a continuous process with a fixed catalyst capable of revivification *in situ* delivering oil without appreciable loss of catalyst—is really not out of sight. An added refinement is the possibility of setting an indicator to deliver automatically a continuous stream of oil of any desired degree of hydrogenation; that is to say, a self-operating mechanical control to alter the conditions necessary to compensate variations in the speed of the process.

* Chem. Soc. T., 1919, 115, 1050.

POST-WAR PROGRESS IN THE FIXATION OF NITROGEN*

THE ARC PROCESS

THE arc process of fixing atmospheric nitrogen was put into commercial operation in Norway as long ago as 1904, and has now reached an enormous development. It was pointed out in the Report of the Nitrogen Products Committee (*cf.* J., 1920, 25R) that although the power requirements of the process are very large, it nevertheless affords the cheapest known method for the manufacture of nitric acid.

It has not been sufficiently recognised that the arc process in its industrial form owes its initiation in a very great measure to scientific researches carried out mainly by British investigators. When, during the war, the writer was privileged to see the whole of the developments at Notodden, also the much larger and newer plants at Rjukan, officials of the Norsk Hydro Company told him that Prof. Birkeland used to recognise frankly that his inspiration to found an industrial process was derived from the famous British Association address of Sir William Crookes, and especially from the quantitative experimental work of the late Lord Rayleigh. At Notodden plant is now installed to utilise about 45,000 kilowatts, and in the two great works at Rjukan there are furnaces employing in all over 200,000 kw., or 270,000 continuous horse-power, this energy being generated at what is almost certainly the cheapest hydro-electric plant in the world. At Rjukan II. a 15,000 kilowatt steam-operated set has now been added to utilise waste steam raised in the boilers employed in the cooling of the process gases, which leave the furnaces at about 1000° C. During the later war period almost the whole output of these enormous works came to France and England for munition purposes.

Though the arc process has now reached the stage of a magnificent engineering achievement, it must be remembered that less than 2 per cent. of the electrical or heat energy expended in the average arc furnace is absorbed as chemical energy in the initial oxidation of the nitrogen. The concentration of nitric oxide in the gases leaving the furnace averages only about 1.2 per cent., and therefore it is not surprising that many suggestions have been made to improve the efficiency of the process, and all kinds of alternative forms of furnace plant have been proposed. Some of these have been tried during the war, and about fourteen are plants of various types, mostly of small output, are now distributed throughout the world.

One of the more important variants of the original process depends on the use of enriched air, instead of common air. This has been used on a considerable scale by a company operating

* The substance of a paper read by Dr. J. A. Harker, F.R.S., before Section B (Chemistry) of the British Association, Hull, 1922.

works in Switzerland and in Germany. The oxygen content of the air utilised is increased to 50 per cent., and to prevent loss of oxygen the whole operation is carried out in a closed circuit. The product, instead of being absorbed in towers, is generally removed by cooling, as liquid nitrogen peroxide. Although under certain conditions the increase in yield of fixed nitrogen obtained from the enriched gas was considerable, and though many tons of liquid nitrogen peroxide were made by the process, certain serious difficulties were encountered, and several explosions have recently occurred in these plants.

The nitric-acid works on the Birkeland-Eyde system, erected during the war in France, are now closed, in order that the power may be used for its original purpose—viz., railway electrification.

SYNTHETIC AMMONIA PROCESSES

Originally worked out by Haber and his colleagues, among whom I should specially mention Dr. Le Rossignol, who is an Englishman born in Jersey, and Dr. H. C. Greenwood, the brilliant young investigator whose death three years ago we all deplore, the process was translated into a technical success by the Badische company, and is now employed on a huge scale in its works at Oppau, on the Rhine, and in the much larger works only recently completed at Merseburg, in Saxony.

But to day this is by no means the only process for the manufacture of ammonia from its elements. The accompanying table shows that there are now quite a number of other synthetic-ammonia processes, and summarises the more important facts regarding their individual characteristics.

The original German process operates at 200 atmospheres, now considered only a moderate pressure. In order to secure autothermic working, very large units are employed and the gas velocity is kept low, the reaction vessels being enormous flanged tubes of steel, nearly 40 ft. long and over 3 ft. external diameter, with walls 6 in. thick. The gases are pre-heated before being passed over the catalyst, and are recirculated through the system, after removal of the ammonia they contain.

In the process worked out independently during the war in the research laboratory of the Nitrogen Products Committee, at University College, London, much higher gas velocities were employed. It was found that under these conditions the yield of ammonia from a given quantity of good catalyst material can be increased enormously, and in the technical plant which was designed it was planned to obtain about 5 kg. of ammonia per hour for each litre of space filled with catalyst, instead of about 400 g. as in the original German system.

In the plant to produce 11,000 tons of nitrogen annually in the form of ammonium nitrate, erected at Sheffield, Alabama, by the U.S. Government in 1917-18, and working on lines not greatly differing from the German process, activated sodamide was used as catalyst material. This was difficult to prepare in bulk, and its activity, though at first fairly high, was permanently destroyed even by small quantities of water vapour. Therefore it was not surprising that this plant did not reach the stage of commercial operation. But, profiting by the lessons of this comparative failure, an American company, formed by the General Chemical Co. and

Forms of the Synthetic Ammonia Process

Country and Date	Process	Operating pressure Atms.	Approx. space-time yield kg. lit. cat. hr.	Approx. percent-age conc. NH_3	Method of removing NH_3	Source of hydrogen	Remarks
Germany (1913)	Haber - Bosch (Badische Co.)	200	0.3 to 0.5	7-8	(a) Cooling (b) Solution in water	Water gas catalytic process do.	Very large units, low gas velocity, circulation. Pre-heating. Process in large-scale operation.
England (1917)	Ministry of Munitions (Greenwood and associates)	150	5-20	2-4	Solution with temp. cycle	do.	Much higher gas velocity; some electric heating. Experimental scale only.
" (1921)	Synthetic Ammonia and Nitrates, Ltd., Brunner Mond & Co., Billingham	—	—	—	—	—	Experimental works plant working 2 tons per day.
U.S.A. (1918)	General Chemical Co. (Sheffield, Alabama)	under 100	about 0.4	8	Cooling to 30° or 40° C.	Water gas catalytic process	U.S. Govt. Works, designed for 11,000 tons N annually. Not now in operation.
" (1920)	Atm. Nit. Corp. Solvay Process Co., Syracuse	—	—	—	—	—	Working on a scale of 10 tons NH_3 per day. Circulation.
France (1920)	Claude	900-1000	about 5	25	Condensation at atm. temp.	Various	Working on scale of 5 tons a day. Three stages in series. No circulation.
Italy (1922)	Casale (Soc. Idros Terni)	about 500	—	—	Solution	Electrolytic	Working on a scale of about 4 tons per day. Circulation.
" (1922)	Pfauiser	—	—	—	Solution	Electrolytic	—
Norway (1921)	Cederberg	—	—	—	—	—	—

the Solvay Process Co., has erected near New York an improved plant on lines not dissimilar to those followed at Sheffield. For over a year this has now been producing liquid ammonia for the refrigerator industry at the rate of 10 tons per day.

The process invented by M. Claude, the special characteristic of which is that it operates at a very high pressure (about seven tons to the square inch), has been described in detail both by Claude himself and more recently by J. H. West (*cf.* J., 1921, 420 R). It differs mainly from the older Haber process in that under the very high working pressure adopted (about 900 atms.) the percentage combination attained in the gases after a single passage is about 40 instead of 10-11, giving about 25 per cent. of ammonia in the issuing stream. The yield of ammonia per litre of catalyst per hour in technical operation reaches the high value of about 5 kg. Multiple-stage working is adopted instead of recirculation of the gas, and the dimensions of a full-sized unit plant giving a technical output of 5 tons per day appear almost absurdly small in comparison with the monumental structures employed in the German process. M. Claude is now using a new form of catalyst tube, made by a well-known firm of steelmakers in Sheffield, of a new material having very remarkable properties at high temperatures. These tubes stand up extremely well to the trying conditions, and promise to give a safe industrial life much longer than anything previously attained. In the Badische process the cost of preparing and purifying the hydrogen used amounts to from 65-70 per cent. of that of the ammonia produced. It is therefore evident that hydrogen production is of paramount importance, and it is to the preparation of cheap hydrogen by a new process from the gases of the coke ovens at Bethune that Claude is at present devoting his attention.

In the Casale process, as now running at Terni, near Rome, the hydrogen is obtained electrolytically from large cells of a new type operated by hydro-electric current obtained from the great waterfalls near by. Some of this hydrogen is burnt with air, and thereby the required mixture of hydrogen and nitrogen is produced. Much attention is now being given to the question of the bulk generation of electrolytic hydrogen. New types of cell of large capacity have been worked out by inventors in this country and in Switzerland, Italy, and America.

Several proposals are on foot in different parts of the world to use electrolytic plants on a very large scale for producing hydrogen required in the manufacture of synthetic ammonia. There is good reason to believe that under existing conditions, and with coke at its present price, hydrogen produced in bulk at a favourable site from cheap hydro-electric power will easily be able to compete with that obtained by other methods. To ensure this, however, the type of

cell employed requires to be much cheaper than previously, in order to keep down the capital cost of the electrolytic plant, which otherwise would be almost prohibitively large.

CYANAMIDE PROCESS

The cyanamide process, which, though stated by many authorities to be obsolete, or at any rate obsolescent, had at the end of the war an aggregate capacity in tons of nitrogen distinctly greater than that of any other method of fixation. It is quite true that since the armistice many of the works erected or enlarged during the war period have been closed. In some cases their situation was unfavourable for post-war commercial operation, and some of those whose output was used as a source of ammonia for munition purposes are unable, under present conditions of cost of labour and raw materials, to operate for the commercial manufacture of fertiliser.

The largest cyanamide works in the world, capable of producing about 200,000 tons annually, and erected during 1918 by the American Government at Muscle Shoals, in the wilds of the cotton-growing district in Alabama, is one of these. We in England used sometimes to say, five years ago, that Uncle Sam was rather slow in making up his mind to come into the war, but there is no doubt that when he did come in he put his hands into both pockets and spent money like water. The American nitrogen programme, including the expenditure on unfinished plant, scrapped at the time of the armistice, cost no less than \$140,000,000. Muscle Shoals alone, exclusive of the hydro-electric scheme now being proceeded with, cost nearly twice as much as Gretna. During the past two years all sorts of proposals have been made as to its future, and at present it is still uncertain whether the Government will lease it to Henry Ford or some other private interest, or will keep it, and the synthetic plant at Sheffield, wrapped up in cotton wool, ready for the next war.

So far as can be ascertained, there has been no new development of outstanding importance in the manufacture of cyanamide itself, although detailed improvements have been made; but, nevertheless, even under the present difficult conditions, cyanamide is still almost certainly the cheapest form of combined nitrogen. In Germany, notwithstanding the recent big synthetic-ammonia developments, plans are now on foot for an immediate approximate doubling of the capacity of the great cyanamide plants at Presteritz, belonging to Messrs. Frank and Caro. Though the German nation cannot pay its just debts, there appears to be still plenty of money for private enterprise.

But cyanamide, when made, is at best an unsatisfactory fertiliser for many soils. When, in the course of an investigation a few weeks ago, the writer had an analysis made of what was probably a rather old sample of cyanamide, to

his surprise he found that the nitrogen content was practically all in the form of dicyanodiamide. If such transformation is common, it is no wonder that the action in the soil is sometimes found to be injurious, rather than beneficial. Many efforts have been made within the last few years to find some process by which cyanamide nitrogen can cheaply be transformed into some other compound. As pointed out in the Report of the Nitrogen Products Committee, to transform it to ammonium sulphate is a relatively expensive process. Until lately the researches to this end made in many different laboratories have met with but small success.

An American company is now manufacturing from cyanamide, for export, a concentrated mixed fertiliser in the form of mono-ammonium phosphate, sold under the trade name of "Ammophos." This would appear to be a promising material, but is too costly for many applications. But within this last year independent investigators in Sweden and Switzerland, working along parallel lines, have succeeded in perfecting processes whereby, by the action of carbonic acid, free cyanamide is first prepared from a solution of calcium cyanamide, and subsequently transformed to urea. In the Swiss form of the process, excess of the sulphuric acid employed in the second stage of the transformation is afterwards used to act upon phosphate rock, which is changed to mono-calcium phosphate. The final product is a neutral body known in France and Switzerland as "Phosphazote," having its nitrogen content as urea, and its phosphorus in the water-soluble form. The cost of its manufacture is stated to be by no means high, and, unlike cyanamide, the substance has no deleterious action on the skin or on the bags in which it is packed. It has now been manufactured in Switzerland on a fair scale for about six months, the product going mostly to France for vine culture. The relation of the two constituents can be varied within limits, but the usual form in which the fertiliser is sent out contains 11-12 per cent. of nitrogen as urea and 11-12 per cent. of available phosphoric anhydride. These two new processes, which apparently are in course of rapid development, may prove to be a means of habilitating cyanamide as a product of fixation, and hence may shortly assume considerable importance.

CYANIDE PROCESS

It is only possible to refer very briefly to the cyanide process, by far the oldest practical fixation method, which still attracts many investigators. A British company is continuing its experiments at Birmingham, and in America cyanide is now being made on a considerable scale from cyanamide as a source of hydrocyanic acid for use in plant fumigation. In the opinion of some American experts the costs of producing cyanide by existing methods, such as the Bucher process, are excessive, and the

cyanide process is not likely to be competitive until further research is carried out on the fundamental reactions involved in the preparation of sodium cyanide. These have never been properly studied, and are more complex than was formerly supposed. Investigations with this object are being undertaken by the Fixed Nitrogen Research Laboratory of the American Government.

AMMONIUM NITRATE

After the Oppau explosion mixed salts containing ammonium nitrate will probably be under the ban of many fertiliser dealers, although the substances may nevertheless be perfectly safe, if their possessors are not sufficiently careless or foolish to attempt to remove them by the stimulus of a big blasting cartridge.

THE POSITION IN GERMANY

In 1913 Germany consumed about 200,000 tons of nitrogen, of which about 110,000 tons was imported in the form of Chilean nitrate. The bulk of this large consumption was used in agriculture for the intensive cultivation of crops. Prof. Matignon, of the Collège de France, states that from May 1, 1921, to April 30 of this year, the smaller Germany of to-day consumed 290,000 tons, or 45 per cent. more than in 1913, without the demands of her agriculturalists being entirely met. Furthermore, the whole of this increased total was produced within the country from the fixation and by-product industries.

Even that is not the whole story. The limit of capacity of production of the German works was far from being attained in 1921. Although the German Government pleads bankruptcy, the Badische company appears to have had little difficulty in finding money to repair the enormous damage caused by the great explosion at Oppau last September. It is stated that the works is now on the point of being ready to produce again at full capacity.

At the end of the present year Germany will have at her disposal an internal capacity for the production of fixed nitrogen of about 500,000 tons annually, a total so colossal that she will be entirely independent of all importation. In case of another war, she will thus be assured of the basic materials for a gigantic production of munitions, together with enough fertiliser to enable her to grow a very large share of her own food. It may be justifiable for the Allies to allow our late enemies to put themselves so soon after the war into so strong a position; but, on the other hand, it may be that those whose function it is to see to it that some, at any rate, of the provisions of the Peace Treaty are carried out, are unaware of what is now happening.

Let them beware that whilst Gretna and almost all our own munitions works are calmly being dismantled, the world is not caught napping a second time.

THE BRITISH ASSOCIATION

THE ninetieth meeting of the British Association, held in Hull from September 6 to 13, will be remembered as one of the most pleasant and useful in the long history of the Association. The arrangements were excellently planned, and the attendance of 1730 must be regarded as very satisfactory, particularly in view of the refusal of the railway companies to extend to members the same facilities that are given to race-goers and other pleasure-seekers.

Since the meeting in Edinburgh last year, the Association has received a most generous gift of £10,000 from the Hon. Sir Charles Parsons, and a legacy of £450 from Mr. T. W. Backhouse. Sir Charles Parsons has also financed the production and publication of "A Retrospect, 1831-1921," compiled by the Secretary, Mr. O. J. R. Howarth (*cf. J.*, 1922, 272 R). With these welcome aids to its somewhat slender financial resources, the Association should soon be in a position to increase the grants to research committees, and to extend the scheme of exhibitions to students enabling them to attend the meetings, which was initiated during the past year. Sir Edward Thorpe, the retiring president, has drawn the attention of the Council to the hardship inflicted on students of science by the greatly increased cost of textbooks, and to alleviate the difficulty Sir Robert Hadfield has given a donation of £50 per annum for three years. The Council has decided to allot the money to necessitous students of the poorer provincial universities and technical institutions.

Prof. H. H. Turner, Savilian Professor of Astronomy in the University of Oxford, has retired from the office of General Secretary, and Mr. F. E. Smith, F.R.S., Director of Scientific Research at the Admiralty, has been elected to fill the vacancy so created. Sir Robert Hadfield and Prof. W. A. Bone have retired from the Council, but Chemistry remains well represented by Sir William Pope, Dr. E. F. Armstrong and Prof. A. Smithells.

Arrangements are well in hand for next year's meeting in Liverpool (September 9 to 16), where Sir Ernest Rutherford will preside, and Dr. A. Holt, Mr. Edwin Thompson and the Town Clerk will act as Local Secretaries. Everything points to a very successful meeting, including several departures from precedent which should add to the convenience of members. The invitation to hold the 1924 meeting in Toronto has been definitely accepted; the Dominion Government has voted the sum of approximately £11,000 to assist visitors from Great Britain; and the meeting will probably be held during the first week of September, after members have had an opportunity of travelling around.

The only change in the organisation of the Sections is the introduction of Forestry as a sub-section of Section K (Botany).

Sir Charles Sherrington's presidential address, entitled "Some Aspects of Animal Mechanism," dealt mainly with recent advances in the physiology of the nervous system and the time-honoured problem of ontology. Although we can now explain the *how* of the mechanism of some aspects of animal life, we are still as far off as ever from understanding the nature of the connexion between nervous processes and the corresponding phenomena of consciousness. In an Evening Discourse, entitled "The Atoms of Matter: their Size, Number and Construction," Dr. F. W. Aston described in simple language the results of, and inferences from, recent work in the prolific field of radio-activity, and refreshed us all by giving two new illustrations of the dimension and speed of molecules. He said that if a hole were made in an evacuated electric-lamp bulb of a size to allow the molecules present in air to enter at the rate of one million per second, one hundred million years would elapse before the bulb was full. Again, if a tumblerful of water were distributed throughout all the waters on the globe, then each tumblerful taken from these waters would contain 2000 molecules of the original tumblerful.

CHEMISTRY

Although the meetings of Section B, in common with those of most other sections, did not attract such large audiences as did last year's meetings in Edinburgh, the attendance was nevertheless very good, and there is no doubt that the programme arranged by the Recorder, Prof. C. H. Desch, with the help of the Organising Committee, was much appreciated. The success of the gatherings was due in no small degree to the ability and geniality of the President, Principal Irvine, who, moreover, set a very high standard in his presidential address; the Section does not often hear such a masterly account of new researches of great scientific, as well as of potentially industrial, importance.

General regret was felt at the unavoidable absence of Prof. A. F. Holleman, who was to have read a paper on "The Rule of the Conservation of Substitution-Type in the Benzene Nucleus," but in place of this a valuable pioneer paper, not previously announced, on "Solid Disperse Systems in Air" was read by Dr. R. Whytlaw-Gray of Eton College. The papers of Prof. J. W. McBain, Dr. J. S. Owen and of Principal Irvine's co-workers also dealt with the results of original research. The joint discussion with Section K (Botany) on Photosynthesis was well staged, and though it brought out prominently the somewhat widely differing outlook of chemists and biologists, it doubtless proved as useful to the protagonists as it was interesting and stimulating to the large audience. Very useful papers were contributed to the discussion on the Nitrogen Industry, and that by Dr. J. A.

Harker obtained very wide publicity in the daily papers. In contrast to this, the discussion on "Valency and Polarity in Organic Compounds," to which Prof. R. Robinson and Dr. J. Kenner made weighty contributions, was somewhat too abstruse for many of those present; but no criticism of this kind could apply to the very lucid expositions on the "Hydrogenation of Fats" given by Dr. E. F. Armstrong and Mr. E. R. Bolton. Reports were presented by the Committees on Colloids, Fuel Economy, and Absorption Spectra, but none of these was discussed.

Hull is a very favoured locality from the point of view of chemical industry, and the excursions to works, organised by Mr. A. R. Tankard, local secretary to the Section, proved very popular. The special thanks of the Section are due to the directors of the following companies for their generous hospitality: The British Oil and Cake Mills, Ltd. (seed-crushing and solvent extraction, soap, margarine); C. & T. Earle, Ltd. and the Humber Portland Cement Co.; Reckitt & Sons, Ltd. (ultra-marine, starch, metal polishes, etc.), and the Frodingham Iron and Steel Co., Scunthorpe.

We give below further abstracts of papers presented, together with a *résumé* of a paper on the resistance to fire of concrete, read before Section G (Engineering) by Prof. F. C. Lea and Dr. R. E. Stradling of Birmingham University, and some remarks from the joint discussion on Vitamins held by Sections I and M (Physiology and Agriculture).

The Composition of Esparto Cellulose

By E. L. Hirst

Esparto grass, after removal of waxes, lignins, etc. in the ordinary course of paper-making, gives a material which is homogeneous and similar in appearance to cotton cellulose, but differs markedly from it in giving on distillation with 12 per cent. aqueous hydrochloric acid an amount of furfural corresponding to the presence of 18–20 per cent. of a pentosan.

Esparto cellulose is not acetylated so readily as cotton cellulose, but by slightly modifying Barnett's method, in which sulphuryl chloride is used as catalyst, almost quantitative yields of acetates have been obtained without appreciable loss of the pentose-content as shown by furfural estimations. This acetate mixture has been subjected to the action of acid methyl alcohol in sealed tubes at 130° C., when it is found that after prolonged digestion practically the whole of the material dissolves and the solution then contains methylglucoside together with a proportion of a methyl pentoside. That the pentose is identical with xylose has been confirmed by isolating from esparto cellulose a pentosan which on hydrolysis is converted into a reducing sugar identical with ordinary xylose. In the course of quantitative experiments esparto cellulose has thus been converted into methylglucoside and methylxyloside in such a manner that 90 per cent. of the whole material can be accounted for. The analytical results indicate that the over-all yield of methyl-

glucoside is 95 per cent. and that of methylxyloside 63.5 per cent. of the theoretical amount, calculated on the assumption that only glucose and xylose residues are present. The loss in yield, as indicated by the results of control experiments, is due to the destruction of pentose owing to furfural formation during the digestion in the sealed tubes.

The evidence therefore points to esparto cellulose being, to the extent of 90 per cent. at least, a definite chemical substance composed of glucose residues and xylose residues present together in the proportions of 80 per cent. and 20 per cent. respectively.

Determination of Compressibilities up to High Pressure and Applications to High-Pressure Chemistry

By E. D. Williamson

A new form of pycnometer has given satisfactory results, particularly in determining compressibilities at the lower end of the pressure range. By means of a movable electrical contact, the instrument allows of continuous readings without removal from the pressure chamber.

In the study of the chemical effects of pressure on systems of more than one component, it is necessary to know the compressibility of each solution in order to compute the volume changes on which these effects depend. The volume changes can be readily calculated from the slopes of the density-composition curves. Even in the case of a simple system, such as a salt and water, it is necessary to make a number of other measurements in addition to those of compressibility. For instance, good density-composition data must be obtained at atmospheric pressure. Also, some form of equilibrium determinations, such as those of vapour pressure or EMF, must be made in order to calculate the initial differences in "free energy" (used in the same sense as by G. N. Lewis) between the solid salt and salt in solution. For the case of $H_2O-NaCl$ almost all the necessary data for the complete elucidation of the system under pressure have been obtained, and a beginning has been made with some others.

Hydrogenation of Fats

This discussion was opened with an address by Dr. E. F. Armstrong, who said that fat-hardening presented problems which brought in almost every aspect of the chemist's work and nearly every trick of his art. Fat-hardening was discovered in theory by Sabatier and in practice by Dr. Normann whose small-scale experiments paved the way for the elaboration of the process on an industrial scale in England. The enormous number of patents, very few of which were of any value, which had resulted was typical of chemical industry, and he regarded this as one of the drags upon the wheels of progress which ought to be removed. Fat-hardening had been much delayed by the difficulties experienced in manufacturing hydrogen, but many of these had now been overcome. Inventors of processes for making hydrogen seldom took into consideration all three factors involved, viz., the capital cost of the plant, operating costs, and the cost of maintenance and repairs. In localities where cheap power was available, there was no difficulty in making cheap hydrogen by the electrolytic method, and he under-

stood that it was being produced on the continent with the aid of cheap water power at 2s. 6d. per 1000 cb. ft. The process adopted by the Badische company was preferable when hydrogen was required in very large quantities, but the ordinary catalytic process was best for small plants. Dr. Armstrong then described the preparation of the nickel catalyst used in hydrogenation and emphasised the points that the efficiency of the catalyst depended upon the existence of maximum surface, and that the oil to be hydrogenated must be clean. The remainder of the address was devoted to an explanation of the manner in which the catalyst brings about the hydrogenation, viz., by the intermediate formation of an unstable additive compound of the nickel and the fat. (*Cf. J.*, 1920, 249 R; 1922, 67 R, 304 R.)

Aerosols, or Solid Disperse Systems in Air

By R. Whytlaw-Gray and J. B. Speakman

Dilute smokes analogous to the solid-liquid systems of colloidal solutions can be formed, (a) by heating substances of high boiling-point in a rapid air stream (paraffin wax, acetanilide, *ortho*-phthalic acid, and diphenylamine disperse readily); (b) by the arc discharge from metallic electrodes in an air current, forming with most metals an oxide dispersoid, and with silver, gold, and platinum a metallic one; (c) by chemical interaction between highly diluted vapours or gases, i.e., zinc ethyl and air or ammonia and hydrogen chloride. An ultra-microscopic method has been developed of counting the number of particles in a given volume of these smokes and by working with a large volume of dispersoid (1 cb. m.) the changes that take place have been followed and shown to be due to aggregation. Different substances form aggregates or complexes of various structures, those of zinc and cadmium oxides giving irregular flexible threads in which the particles appear as beads on a string and exhibit remarkable Brownian motion.

The curves obtained by plotting the number of particles per c.c. against time showed in all cases a steep initial drop corresponding with the period of most rapid aggregation.

The weight of the particles in a given volume was found by filtration through asbestos and weighing the small filter on a micro-balance sensitive to 0.0002 mg. and the resulting weight-time curves showed that the weight falls off much more slowly than the number of particles. By combining the two sets of curves it was possible to calculate the sizes of the particles: these were found to increase with time and then become constant.

Liquid and solid disperse systems are produced in a large number of chemical operations, such as the passage of gases through liquids and the decomposition of solids by heat, and this possible source of error in measurements of high accuracy does not seem to have been considered.

The Study of Soap Solutions

By Prof. J. W. McBain

In view of the large number of current theories which are irreconcilable with the conclusions to which the study of soap solutions has led it is necessary very carefully to prove the evidence for the existence of the ionic micelle.

1. The following methods agree in showing that hydroxyl ion is only a minor constituent of soap

solutions (about 0.001N):—Electromotive force with hydrogen electrode; catalysis; conductivity; ultra-filtration with direct analysis of the filtrate.

2. The osmotic activity is about half that of a salt. Trustworthy measurements have been obtained by the following methods:—Freezing-point; dew-point; minimum pressure required for ultra-filtration; vapour pressure.

3. The conductivity is that of a salt; this is indicated by hundreds of concordant measurements with many kinds of soap.

4. Half the conductivity must be ascribed to a constituent of very high equivalent conductivity but of negligible osmotic pressure, the ionic micelle. Its conductivity is several-fold that of all the fatty ions contained in it.

5. By ultra-filtration the ionic micelle is found to be colloidal, and, in addition, the undissociated neutral colloid, consisting of still larger particles, may be separated from the ionic micelle. Sodium and potassium electrodes confirm the concentrations of sodium and potassium ions assumed. Migration determinations are also in agreement. Hydrolysis is impossible in the case of *octyl* sulphonic acid, whose behaviour is closely similar.

6. An important result is the theory of gel structure. The only differences between a transparent jelly and a sol are mechanical—elasticity and rigidity. The colloidal particles in both are identical in nature and amount, but in the gel they are arranged in ultra-microscopic filaments or aggregates. The equilibria and the resistance to the passage of the electric current are unaltered on gelatinisation.

7. "Electrical endosmosis" and "cataphoresis" in a transparent soap jelly are quantitatively identical with electrolytic migration in the corresponding soap sol.

8. The theoretical conclusions are of general applicability to very large groups of organic and inorganic solutions in aqueous and non-aqueous solution.

Raw Materials for Synthetic Ammonia : The Manufacture of Hydrogen and Nitrogen

By J. H. West

There are two main sources of commercial hydrogen—coal and water. Electrolytic hydrogen is very pure, but owing to the high capital cost of the plant and the great consumption of electric energy, the cost of production is prohibitive unless cheap water-power is available. Many coals contain about 5 per cent. by weight of hydrogen, equivalent to about 21,000 cb. ft. per ton of coal, but only about one-quarter of this amount is set free on distillation of the coal in retorts or coke ovens. Coke-oven gas, where available, is an excellent source of hydrogen, when the latter is separated from the other gases by Claude's liquefaction process. The interaction of steam and hot coke gives water gas containing about 50 per cent. of hydrogen and 42 per cent. of carbon monoxide, the yield being about 55,000 cb. ft. of gas per ton of coke. The carbon monoxide in water gas may be caused to react with steam, giving carbon dioxide and hydrogen.

The process devised by Dr. A. Jaques and the author combines the distillation of coal in a retort, the formation of water gas from the resulting coke,

and the conversion of the carbon monoxide produced in these two operations into carbon dioxide and hydrogen by reaction with steam in presence of a catalyst, in one apparatus, thus giving a maximum yield of hydrogen. Nearly all the hydrogen in the coal is liberated by passing the crude coal gas through a hot zone in the producer, so that all tar, oils, and hydrocarbons, such as methane, are cracked or split up into hydrogen and carbon, the carbon reacting with steam to form water gas. The process is carried out in a modified form of Tully complete-gasification plant, and the only products are gas and ashes.

Nitrogen can be made in an ordinary liquid-air plant, the separation from oxygen being effected by fractional distillation. Another method is to burn out the oxygen of air with hydrogen. In other words, a measured quantity of air is added to the hydrogen and the mixture is passed over a catalyst, so that combustion takes place quietly, and a mixture of hydrogen and nitrogen in the desired proportions results.

In the Haber process water gas is mixed with air producer gas, so that sufficient nitrogen remains in the mixture after treatment for conversion of the carbon monoxide, the final adjustment to the exact proportions being made by adding a little pure nitrogen obtained from liquid air.

The Häusser Process of Nitrogen Fixation

By C. J. Goodwin

The commercial success of the manufacture of synthetic ammonia in conjunction with the Ostwald process of obtaining nitric oxides and nitric acid by combustion of the ammonia, has created the impression that in the near future such ammonia will be the principal raw material for nitric-acid manufacture. Colour is lent to this view by the economic failure of the arc process, except under exceptionally favourable conditions, and by the price conditions obtaining in the markets for nitrate of soda and sulphuric acid. Economically, and on general principles, such an assumption seems unsound provided there is an assured output for all the synthetic ammonia produced, because, even if the loss on conversion is small, it would be irrational to make ammonia in plant involving high capital costs if nitric acid could be made directly in cheaper plant at the same cost. Recent developments in the Häusser process have brought the commercial realisation of this statement within sight. The details of Häusser's researches and trials were recently communicated to this *Journal* (1922, 253—259 n). The normal development of this method of nitrogen fixation was suspended during the war, and in this country the Nitrogen Products Committee in its final report (publication of which was delayed until 1920) rightly concluded that other processes would give more immediate and satisfactory results.

In the present paper it is shown that the impending trials with a 1200 to 1500 litre bomb are likely to lead to commercial yields. Modern alloys and unobtainable steel have assisted in overcoming difficulties in wear and corrosion, and the volume of the absorption tower system has been reduced to one-sixtieth of the normal by absorption under $2\frac{1}{2}$ to 4 atmospheres pressure in chromium-nickel-steel or silicon-iron towers. A yield of 150 grams of nitric

acid per cubic metre of coke-oven gas is anticipated. The plant requires no external energy for driving compressors, etc. It is possible that by using a special gas engine or a kind of Humphrey pump, a greater proportion of the calorific power of the gases or liquid fuels might be converted into useful energy, but such a plant would necessarily be more complicated. Finally the importance of using gases of high calorific value as giving higher temperatures and yields is emphasised, and methods are indicated by which coke-oven and similar gases can be enriched to meet these conditions. It is suggested that Häusser plants can be usefully developed either as adjuncts to synthetic ammonia plants, at coke-oven plants, or in places where liquid fuel is cheap and the cost of making nitric acid is relatively high. Such plants can be relatively small, whereas other methods involve production on a very large scale to render them commercially successful.

Some Aspects of the Relationship between Water-Power and Nitrogen Fixation

By E. B. Maxted

The fixation of nitrogen by any of the three principal processes, namely as nitric oxide in the high-tension arc, as cyanamide, and as synthetic ammonia, involves in each case two economic factors, which may conveniently be grouped under the heading of power and of materials respectively. On the predominance of the one or of the other of these two classes will depend the practicability of any one of the processes under given geographical conditions. From this standpoint, the arc process is necessarily confined to countries suitable for the development of cheap hydro-electric power, whilst the production of cyanamide, by reason of the balance between the material and the power factors, is capable of establishment either at the source of cheap power or at the site of the necessary raw materials.

The synthesis of ammonia, by virtue of its low power-factor, possesses the unique advantage of being independent of peculiar geographical conditions, provided that the hydrogen utilised is made from fuel. It is, however, of interest to regard the synthesis of ammonia as a possible outlet for water-power, the hydrogen being in this case made electrolytically, and from this standpoint to obtain data concerning the relationship of electrolytic hydrogen produced from water power to hydrogen produced from fuel; further, to see what economic advantage, if any, is obtained by applying water power to the synthesis of ammonia in this way, rather than for the fixation of nitrogen in another form, such as calcium cyanamide, in each case under the conditions which exist in Great Britain.

The potential resources of water-power in this country have recently been surveyed by the Water Power Resources Committee of the Board of Trade. In the course of this survey, water resources estimated to be capable of producing about 250,000 kw. were examined in detail. This figure is not exhaustive, and is exclusive of the Severn Estuary scheme. By far the larger proportion of potential water power sites of any considerable magnitude are located in Scotland. An important factor in the present case consists in the maximum power available at a given site. Of the ten Scottish loch and

river sites reported on favourably by the engineers retained by the above committee, only one was estimated to produce over 30,000 kw., and only two over 20,000 kw., the average power of the ten sites being about 10,000 kw. In Wales, of the five sites reported on, only one was estimated to have a potential output greater than 5000 kw.

On the basis of the above survey, it would appear that water-power on a considerable scale could be developed in Great Britain and that, under present conditions, it should be possible to produce hydro-electric energy from several of the more suitable sites for about £4—£5 per kilowatt-year, the greater part of this cost representing interest on the capital cost of the installation. If a power consumption of 135 kw.-hr. per 1000 cb. ft. of hydrogen produced by electrolysis be assumed—a figure which conforms to the results obtained in practice—the cost of power should be about 1s. 7d. per 1000 cb. ft. of hydrogen, the value of the oxygen being disregarded. This figure does not compare unfavourably with the cost of hydrogen made from fuel. The principal disadvantage of the electrolytic process consists in the relatively large floor space required, and in the multiplicity of cells necessary. This is being met to a certain degree by the gradual introduction of large unit cells; and the extent to which this enlargement is practicable, together with the even more important desirability of a relatively high operating current-density, will probably determine the industrial future of electrolytic hydrogen, at any rate for cases in which the oxygen is not utilised. The utilisation of relatively large supplies of cheap oxygen in chemical industry presents, moreover, in this connexion an important field for research.

The problem may also be considered from a slightly different standpoint. Let it be assumed that power of a given magnitude, for instance, 10,000 kw., is available at a given site; and let this power be utilised completely, firstly for the synthesis of ammonia (the hydrogen being generated electrolytically), and, secondly, for the production, for instance, of calcium cyanamide. In the first case, some 5000—5500 tons of nitrogen per annum would be fixed as ammonia, about 7500—8000 of the 10,000 kw. available being used for electrolysis. If, on the other hand, the 10,000 kw. were used for the fixation of nitrogen as cyanamide, the weight of nitrogen fixed per annum would be about the same, the important difference being, however, that, in the case of synthetic ammonia, about 33,000 cb. ft. per hour of waste oxygen would be available from the hydrogen and nitrogen plants—assuming the latter gas to be made from air by a process of low temperature separation—whereas, in the case of cyanamide, the whole of the anthracite and lime required would have to be brought to the site of the factory and there handled. This would be balanced to a certain degree by the greater simplicity of the cyanamide method, and by the necessity for fixing the ammonia by means of an acid.

Consideration of the nitrogen problem from the above standpoint is of interest in that it brings the synthesis of ammonia into line with the other processes of nitrogen fixation in regard to a choice between fuel and water-power for their operation. Although the presentation of the matter in this light is not intended as a definite argument for the preferential manufacture of such large quantities of hydrogen by electrolysis, it would appear that the

utilisation in Great Britain of hydro-electric power for such purposes is not impossible.

The Resistance to Fire of Concrete and Reinforced Concrete

By F. C. Lea and R. E. Stradling

The authors considered the problem under two headings, viz., the possibility of making a concrete which shall retain its strength after exposure to high temperature, and the possibility of preventing steel from reaching such a temperature that its strength is reduced to or below that required to carry the loads. In testing the action of fire on concrete, the authors experimented on the expansion of quartz and set cement, and found that at about 575° C. quartz changes to the β form and undergoes a linear expansion of about 0.4 per cent. The expansion of set cement is normal, and approximately equal to that of steel, up to 93° C.; between 100° C. and 491° C. it contracts, but expands again above the latter temperature. The authors conclude that water is continually driven off throughout the heat treatment, but at different rates for different temperature ranges, the greatest being between 98° and 102° C. Between 300° and 500° C. the rate is fairly constant, but falls off after the higher temperature has been passed. At temperatures above 400° C. the calcium hydrate is dissociated into quicklime and water.

Experiments were also carried out on the reduction in strength of sand-cement mortars and concrete, under the application of heat. Various mortars composed of Leighton Buzzard sand and cement were used, and it was found that with a 1:1 mixture for temperatures below 400° C. there was a gain in the tensile strength of the specimen, the maximum gain being about 22 per cent. at 100° C. Increase in temperature above 400° C. led to loss in strength, and at 830° C. this loss amounted to 91.1 per cent. With mixtures containing more sand, the range of temperature within which a gain of strength occurred was less, and the loss of strength was more rapid at higher temperatures. Concrete made of ground brick and cement was found to gain in strength between 0° and 650° C.; above the latter temperature there was a loss in strength, which, however, did not take place so rapidly as in the sand-cement mortar, being only 55 per cent. at 1030° C. The authors also found that if the specimens after heat-treatment were exposed to the atmosphere for some time they lost strength quite out of proportion to the amount of heating; that cracks would appear on the surface; and that the block might crumble to pieces. This is attributed to hydration of the quicklime, formed during heating, by atmospheric moisture.

Concrete fails owing to the relative movement of the sand grains and the cement, brought about by the different coefficients of expansion, and this type of failure can be partially obviated by using rather different materials. When this is done the failure on heating is due to breaking down of the cement itself. In reinforced concrete, when the temperature is raised above 100° C., contraction occurs in the concrete whilst the steel reinforcements expand. This tends to break down the adhesion between the concrete and the steel, either by the complete sliding of the steel through the concrete or by the cracking of the concrete itself.

The authors make several suggestions for overcoming this defect, but state that large-scale experiments would be required to test them.

Vitamins

Prof. J. C. Drummond pointed out that plants were to be regarded not only as machines for storing solar energy, but as laboratories in which certain substances were prepared that the animal body was unable to make for itself. We knew the constitution of some of these substances, e.g., the amino-acids, tryptophane, and cystine, but there were others, the identity of which was still obscure, commonly known as vitamins A, B, and C. Whereas two of these were produced only by green plants, it appeared that the third could be manufactured by such low forms as yeasts and bacteria growing in culture media. On the other hand, the recent studies which showed that rickets could be cured not only by vitamin A, but also by exposure to sunlight or ultra-violet light, suggested the possibility of a synthesis of vitamin A by animal tissues. Prof. Drummond uttered a warning with reference to the food of the industrial population of this country. The consumption of milk per head was much lower than that of other countries, and the use of margarine had largely replaced that of butter; the most dangerous feature of all was the widespread neglect of fresh green foods.

Captain J. Golding described experiments in which the importance of vitamin A was demonstrated in the rearing of pigs. Under the experimental conditions it was found that the limitation of growth and development of the young pig was dependent on the amount of the vitamin which had been transferred from the mother during suckling. It was evident that if this amount was in excess of immediate requirements, it could be stored in the fat of the young pig, and no signs of deficiency followed a deficient diet until this store was exhausted. Further results were given showing that prolonged deficiency of the factor A might do irreparable harm in the matter of reproduction. Whilst in practice the danger of vitamin deficiency was largely confined to sty-fed pigs, it also occurred in others. During last summer (1921) a big herd of young pigs kept on a dry upland pasture was found to be suffering from failure of growth and joint trouble. The pigs were at once cured by bringing them to a fresh green pasture or by giving them lucerne. Agriculturists were warned against artificial foodstuffs advertised as containing vitamins, for these were generally a cloak for a lack of nutrient materials. Apart from cod-liver oil, the farmer should look to his natural foods to supply vitamins.

Among other papers presented to the meeting were:—*Section A (Mathematical and Physical Science)*: X-Rays and Beta Rays: M. le Duc de Broglie; The Law of Distribution of Particles in a Colloid Suspension: Prof. A. W. Porter; X-Ray Electrons: Prof. R. Whiddington. *Section D (Zoology)*: Presidential address by Dr. E. J. Allen on The Progression of Life in the Sea (including observations on the production of Vitamin A by plankton diatoms); The Hydrogen-Ion Concentration of Soils and Natural Waters in relation to Animal Distribution: Dr. W. R. G. Atkins; Fresh-Water Fauna of Aberystwyth Area in relation to Lead Pollution: Miss K. Carpenter. *Section F (Economic Science and Statistics)*: The Future of

Unemployment Insurance: J. L. Cohen; Equal Pay to Men and Women for Equal Work (presidential address): Prof. F. J. Edgeworth. *Section G (Engineering)*: Home-produced Oil Fuel: Dr. C. H. Lander. *Section I (Physiology)*: The Efficiency of Man and the Factors which Influence (presidential address): Prof. E. P. Cathcart; An Estimation of the Practical Agricultural Importance of Vitamin A in Feeding Pigs: Capt. J. Golding; Further Studies on the Isolation of the Antineuritic Vitamins: Dr. A. Seidell. *Section J (Psychology)*: Industrial Psychology and the Efficiency Engineer: Dr. C. S. Myers. *Section K (Botany)*: On the Transport of Organic Substances in Plants (presidential address): Prof. H. H. Dixon. *Section L (Education)*: Educational and School Science (presidential address): Sir R. A. Gregory. *Section M (Agriculture)*: The Use of Lime in the North of England: J. A. Hanley; The Limitations of Laboratory Methods of Lime-Requirement Determination: N. M. Comber.

The presidential addresses have been published in a separate volume by John Murray (price 6s. net).

APPEAL ON BEHALF OF RUSSIAN MEN OF SCIENCE

THE following is the text of a letter, dated September 30, addressed by Sir James Walker, President of the Chemical Society, to its Fellows. We reproduce it here in the hope that it will evoke a response among members of the Society of Chemical Industry and among other readers of this *Journal*.

In September of last year, in consequence of the information received as to the deplorable conditions under which Russian men of science were placed, I issued an appeal to the Fellows of the Chemical Society to assist in the alleviation of the acute distress prevailing amongst their colleagues in Russia.

I have to announce with great satisfaction that in response to this appeal the sum of £214 2s. 7d. was received, besides numerous valuable parcels of clothing, underclothing, boots, and books. Of this sum £170 has been devoted to the purchase of clothing, which has been distributed amongst our colleagues in Ekaterinburg, Moscow, and Petrograd. In addition to this, three cases containing clothing and books have been despatched to Moscow and Petrograd.

The difficulty with which we were confronted, namely the uncertainty as to whether parcels sent from England would reach their proper destinations, has now happily been overcome, definite proof having been received in every case that the goods have reached those for whom they were intended.

In a letter written by one of the workers of the European Student Relief Society to the Friends' Relief Committee, the following passage occurs:—

"The Chemical Society in England recently sent out some scientific journals, etc. through the Friends. They have been entrusted to me for distribution, and when I told some of the Moscow professors of their arrival, their eagerness to see them was like the eagerness of the children in the famine areas to get bread. You can assure all donors that every journal will be properly circulated

in the faculty concerned and be retained in the library."

It will be seen from this how urgent the need still is for scientific books; and from information received from the Committee of Russian Men of Science (a member of which visited this country last spring) the need for every kind of scientific apparatus appears to be equally pressing.

Notwithstanding the useful work that has been accomplished by the different organisations formed to relieve the wants of men of science in Russia, there remains much to be done, for there is every reason to fear that the necessity will be no less acute during the coming winter than it was last year. I therefore issue this appeal to Fellows of the Chemical Society and to British chemists generally to render every assistance within their power, in a confident hope that a generous response will be forthcoming.

In addition to donations of money to be devoted to purchasing requisite articles, gifts of clothing (which, if used, must be in good condition), and recent chemical literature, will be welcome. The Chemical Society will continue to act as the receiving depôt, and cheques (made payable to Mr. S. E. Carr, and crossed "Russian Fund"), together with parcels of clothing, boots, books, etc., should be addressed to the Assistant Secretary, The Chemical Society, Burlington House, Piccadilly, W. I.

JAMES WALKER,
President.

CORRESPONDENCE

THE TRAINING OF THE CHEMICAL ENGINEER

Sir,—I have read with much interest the reports of Dr. Ruttan's address on the training of the chemical engineer (*cf. J.*, 1922, 282 R, 323 R). I am, I believe, the only person in England at the present time who has taken the course of study, which he describes, at the Massachusetts Institute of Technology, so that perhaps my remarks may interest your readers.

I expected great things of the course when I entered upon it; but as the weeks passed, with industry after industry expounded to us, principle after principle elucidated, I was amazed at the value of it all. It could do no less than introduce the students to the seven industries embraced by it: actually, owing to the method of our study, *i.e.*, by "unit operations," it prepared us, not merely for those seven, but for *all* the industries in which chemistry is involved.

The course started just before the United States entered the war, and was broken off in the middle of its first session. After the war it was restarted, in a slightly modified form. In its first post-war year, some of the co-operating companies merely tolerated the students. When I took the course, in its second post-war year (1921), they received us with open arms, a sure sign that our presence was to their advantage as well as to ours.

I understand that English colleges teach chemical engineering by "providing the student with plant and demonstrating to him processes on a semi-large scale," which, Dr. Ruttan says, has not been

successful (*loc. cit.* 282 n). Having experienced the other method, that of teaching by "unit operations," with factories as laboratory and classroom, I humbly and fervently commend that method to our English professors. A good general outline of the idea is given in two valuable articles by W. K. Lewis and R. T. Haslam (the guiding spirits of the course), in the *Journal of Industrial and Engineering Chemistry*, 1921, 13, 465, and 1922, 14, 647.—I am, Sir, etc.,

GEOFFREY J. GREENFIELD.

Langley Park Coke Works Co.,

Durham.

September 10, 1922.

PERSONALIA

Dr. L. Birkenbach, of Munich, has been appointed to succeed Prof. Wilke-Dörfurt in the chair of chemistry at the School of Mines (*Bergakademie*), Clausthal.

Mr. Charles Crowther, the new Principal of the Harper-Adams Agricultural College, Newport, Salop, was for many years lecturer and then for six years professor of agricultural chemistry in the University of Leeds.

Following the death of Prof. W. Wislicenus, Prof. Wieland of Freiburg i/B has assumed the editorship of *Liebigs Annalen der Chemie*. The publication committee consists of Professors A. Wallach, Groebe, Zincke, Willstätter and the editor.

Among those who received the degree of D.Sc. (*honoris causa*) of the University of Leeds, on the occasion of the meeting of the British Association in Hull, were Prof. Sir Charles Sherrington, the Duc de Broglie, Institut d'Optique, Paris, and Prof. P. Weiss, director of the Institut de Physique, Strashbourg.

Prof. R. T. Haslam has been appointed director of the research laboratory of applied chemistry in the Massachusetts Institute of Technology in succession to Mr. R. E. Wilson, who has joined the research staff of the Standard Oil Co., of Indiana. Dr. G. B. Waterhouse has been appointed to succeed Prof. H. O. Hofman as head of the department of metallurgy in the same institution.

Dr. R. C. Farmer has been invited to take up the position of Deputy Director of Explosives Research at the War Office Research Department, and will commence duty in October. Dr. Farmer was formerly Chemical Adviser to the Explosives Department under Lord Moulton, and was a member of the Nitrogen Products Committee and the Chemical Committee of the Munitions Inventions Department. Since the armistice he has been a director of Messrs. W. J. Bush and Co., Ltd., and is now resigning this position.

* * *

Prof. Alfred Getz, professor of mining in the Norwegian Technical High School, Trondhjem, died in August, aged 60 years.

We record with great regret the death, on September 12, of Dr. William Kellner, formerly Chemist to the War Department, and a member of this Society since 1885.

NEWS AND NOTES

FRANCE

Proposed Franco-German Potash Monopoly

The special correspondent of the *Observer* in Paris announces the failure of the negotiations that have recently been taking place between the French owners of the Alsatian potash mines and the German Potash Syndicate which were undertaken to re-establish the world-monopoly that existed before the war, when all the mines were in German territory. It is pointed out that the failure was almost inevitable owing to the enormous advantage that the low exchange-rate of the mark would confer on the German producers.

Industrial Notes

Chemical Industry.—The failure of the negotiations between the representatives of the Alsatian potash mines and those of the Potash Syndicate is apparently due to the fact that the German producers offered only a one-tenth share in the monopoly, on the ground that the German mines have a productive capacity twenty times that of the French. This offer is unacceptable to the French, who contend that they have considerably increased their output and secured important markets abroad. The German representatives naturally will not give way, as German potash is selling at 132.30 francs per metric ton f.o.r. at the mine, whereas the French price is 450 fr.

Investigations have recently been carried out on the production of alloys to withstand the high temperatures and pressures used in the Claude synthetic-ammonia process. It has been found that a steel of the following composition will resist the conditions mentioned for 4000 hours:—Ni 60, Mn 2, Cr 12, C 0.5, and Fe 25.5 per cent.

Metallurgy.—At present the metallurgical outlook is very good. The dissolution of the *Comptoir des Fontes Hématites* has again raised the question of the utility of such organisations. The general opinion is that they are useful if they confine themselves to regulating production and distribution, but harmful if they develop into trusts that attempt to control markets. It is also felt that "comptoirs" might extend their activities to the export trade, provided that in tendering for contracts they would act as promptly as individual firms, and that similar organisations exist abroad. Considerations of this kind suggest the need for an international agreement between the leading metallurgical countries and for more efficient co-ordination of their efforts to meet the world's requirements.

During the first seven months of 1922, 2,689,132 metric tons of pig iron and 2,413,170 t. of steel were produced in France.

Coal.—The state of the coal market continues good, and although the end of the coal strike in the United States will mean renewed competition from British coal, the approach of winter, the high exchange value of the pound sterling, and the greater industrial activity in France, are factors that strongly favour the French coal industry.

Saar coal, which contains about 33 per cent. of volatile matter, yields brittle coke unsuitable for metallurgical use, and the question of surmounting this difficulty has been receiving attention in order to make France less dependent on supplies from

the Ruhr district. Experiments have shown that the brittleness of the coke can be overcome by coking the raw coal with coal that has been partly distilled in a special retort so as to reduce the content of volatile matter to 12 per cent. It is not intended to use this process at the mines, as this would mean costly additions to existing plants, but to explain it to the iron and steel manufacturers, who mostly produce their own coke. The successful application of this process would lead to extensive development of the Saar coalmines.

La Société de Chimie Industrielle

This society held its Second Congress in Marseille during the first week of July. The attendance numbered about 400, and among the foreign guests were Dr. Emil Mond, Prof. W. A. Noyes, Prof. A. C. Langmuir, Dr. C. L. Parsons and Senator Paternò. Monsieur H. Giraud, president of the Marseille Chamber of Commerce, took the chair at the opening meeting, when addresses were delivered by M. Paul Kestner, president of the Society; M. A. Gardair, chairman of the organising committee; Prof. Cavalier; M. H. Giraud; and by M. Deschiens, who in reading the annual report mentioned some of the results of work done during the year. At the instance of the Society the exportation of radio-active minerals from Madagascar to foreign countries was prohibited; the Customs classification of fats was revised; the suggestion that coke ovens should be heated with producer gas instead of with town's gas was referred to the Central Committee of French Coalmines; and representations concerning the mobilisation of technical men in wartime were favourably received by the Minister of War. A striking address was delivered by Prof. C. Matignon on the present state of the German nitrogen industry (*cf. i.*), and M. Sabatier was presented with the Society's gold medal. Many papers were read before the fifteen technical groups into which the congress was divided, and visits were made to local works and to the exhibition of French colonial products.—(*Chim. et Ind.*, Aug., 1922.)

AUSTRALIA

The White-Lead Industry

The manufacture of white lead in Australia has made great progress, for, whereas practically the whole of the requirements was imported seven years ago, now production almost meets the demand. This advance is largely due to the establishment of a branch factory of Lewis Berger and Sons, Ltd., manufacturers of paint and varnish, in Rhodes, near Sydney, in 1916, and which now employs 350 workers. The Dutch process is used and the raw material is lead of 99.9 per cent. purity from Broken Hill. The capacity of the works is 9000 tons per annum.

NEW ZEALAND

Discovery of Franklinite

Great interest has been aroused by the discovery of franklinite, hitherto not known to occur in New Zealand, in the fiord country of Southland. The Government mineralogist has confirmed the identification of the mineral. Franklinite contains about 67 per cent. of iron oxide, 17 per cent. manganese dioxide and 16 per cent. of zinc oxide, and is named after the Franklin district of New Jersey, where it

is mined and shipped to Pennsylvania for the production of zinc and spiegeleisen. Commercial utilisation is only possible if the ore is readily accessible and available in large quantity.—(*Ind. Austr.*, June 8, 1922.)

UNITED STATES

Annual Prize of 25,000 Dollars

At a council meeting of the American Chemical Society, held during the Society's recent meeting in Pittsburgh, a letter was read from Dr. W. H. Nichols to Dr. Edgar F. Smith (president) offering on behalf of the Allied Chemical and Dye Corporation a prize of \$25,000 to be awarded annually to the chemist residing in the United States who, in the opinion of a special jury appointed by the Society, has contributed most to the benefit of chemical science and the world. The scheme will come into effect on January 1, 1923.

"Journal of Physical Chemistry"

At the same meeting of the above-named council, it was resolved that the *Journal of Physical Chemistry* shall in future be published under the joint auspices of the American Chemical Society, the Chemical Society of London, and the Faraday Society. The arrangements were made on the occasion of a recent visit of Dr. C. L. Parsons to London. It has been agreed that the management of the journal shall be left entirely to a board of eight members, who will be nominated by the societies concerned, and who will elect the editor-in-chief and probably also a managing editor. Members of the board will be appointed for a term of two years, one-half will retire each year, and no member shall serve continuously for more than four years. The societies will incur no financial liability, and their members or Fellows will be offered the journal at a reduced subscription rate. Mr. Francis P. Garvan, president of the Chemical Foundation, has guaranteed the payment of \$10,000 per annum for five years to assist the publication.

CANADA

Soapstone in Ontario

The Mines Branch of the Canadian Department of Mines has issued a preliminary account of a large deposit of a mineral resembling soapstone which occurs at Wabigoon, near Dryden, Ontario, and in close proximity to the Canadian Pacific Railway. This deposit, which is stated to be the most promising of its kind in Canada, consists of two well-defined bands of mineral, separated by 100 ft. of hard grit rock, and the smaller of the two has a proved length of 500 ft. and a width of 35 ft. The rock is dark greenish grey, soft, homogeneous, but not greasy to the touch. Its percentage composition has been found to vary within the following limits:— SiO_2 41.94–51.44; FeO 7.24–7.71; Fe_2O_3 2.05–3.68; Al_2O_3 4.79–7.57; MgO 25.39–26.43; CO_2 0.11–5.09; H_2O (above 105° C.) 6.56–6.71. Crushing strength ranges from 10,269 to 12,140 lb. per sq. in.; modulus of rupture from 1827 to 1920 lb. per sq. in.; fusion temperature 1400° C. It is suggested that the mineral might be suitable for making refractory bricks for the smelting furnaces of sulphate pulp (kraft) mills; at present, although the consumption is large, all the soapstone bricks required are imported from the United States. The stone might also be used for making baking-oven bricks, foot warmers, griddles, etc.

BRITISH INDIA

The Rubber Plantation Industry

In 1921 there were 1016 rubber plantations in British India which covered an area of 196,990 acres and produced 4043 tons of rubber, nearly all of which was of the Hevea kind. The chief producing areas are situated in Southern India, Burma, and Assam. In 1920 the production was 6156 t., and the decline in 1921 is ascribed to low prices and the Moplah rebellion. The exports by sea declined by 21 per cent. to 4917 t., of which the United Kingdom took 63, Ceylon 21, the United States 9, and the Straits Settlements 6 per cent. Imports of rubber were very small.—(*Ind. Tr. J.*, Aug. 17, 1922.)

SOUTH AFRICA

The Whaling Industry in Natal, 1921

According to a report of the Durban Chamber of Commerce, the whaling industry of Natal is seriously affected by the prevailing financial depression, the price of whale oil having declined by 65.3 per cent. to £31 5s. per ton in August, 1921. Whale oil was in but small demand in Europe, although exports to the United States continued, and unless the cost of production can be considerably reduced many of the whaling companies may not resume operations. The 1071 whales captured during 1921 yielded 6255 tons of oil (£155,000), 2447 t. of fertilisers (£25,000), and 1045 t. of boiled bone (£8000).—(*U.S. Com. Rep.*, Aug. 14, 1922.)

GERMANY

Hydrogenation of Oils in Presence of Oxygen

In the *Berichte* (1922, pp. 2193–97), Dr. W. Normann criticises the assertion that the presence of oxygen is essential in fat-hardening. His experiments with nickel cyanide, nickel chloride on kieselguhr, powdered nickel, and palladium chloride show that hydrogenation proceeds in the total absence of oxygen, and that the presence of even a few tenths of one per cent. of oxygen is distinctly harmful.

Ammonium Bicarbonate as Fertiliser

The production of ammonium sulphate for use as a fertiliser involves the consumption of large quantities of imported sulphuric acid. The cost of the acid makes the price of the fertiliser high; the acid itself possesses no fertilising value, but tends to increase the acidity of the soil. Ammonium bicarbonate is now recommended as an alternative nitrogenous fertiliser, the production of which only requires ammonia, water, and carbon dioxide, a cheap by-product. The cost of this product should thus be low compared with that of ammonium sulphate. Tests made at the Research and Control Station of the Oldenburg Board of Agriculture have given favourable results both on sandy and on acid moorland soils.

New Applications of Schoop's Metal-spraying Process

Strongly adherent, homogeneous coatings of lead, tin, zinc, aluminium, brass or copper can now be sprayed without the use of compressed oxygen, a small pointed flame of acetylene and compressed air being sufficient. Not only is the cost of transport and hire of cylinders obviated, but the process

is more economical than the older one. For many years coatings of enamel, quartz or glass have been produced by Schoop's process and recently very hard, chemically resistant coatings of a mixture of metal and glass enamel or similar substances have been successfully obtained. Another new application of the process is in the production of coatings of "stainless" steel on metallic objects whereby they may be made non-rusting as well as hard; and further experiments are now in hand which, if successful, will result in the production of machine tools having an outer skin of hard alloy ("stainless" or tungsten steel) on a body of other suitable softer metal.—(*Chem.-Z.*, Sept. 2, 1922.)

The Nitrogen-Products Industry in Germany

In a long article published in the July issue of *Chimie et Industrie*, Prof. C. Matignon discusses the present situation of the German nitrogen industry, in which over one milliard marks are invested. But for this industry, in 1921 Germany would have had to import 1,500,000 metric tons of Chilean nitrate, worth 27 milliards of paper marks; and although this quantity corresponds to an output of 230,000 t. of nitrogen, the total productive capacity of the German factories is far from being attained. By the end of 1922 the total capacity will be 500,000 t. of combined nitrogen, of which 300,000 t. will be produced by the Badische synthetic-ammonia factories, so that, assuming that the coke ovens and cyanamide factories work at only half capacity, the German output of fixed nitrogen will then be at least 400,000 t., i.e., more than half the world's pre-war consumption of 692,000 t. In time, therefore, Germany will be able not only to meet the increasing needs of her own agriculture but also to export nitrogenous fertilisers, which, favoured by the low value of the mark, will compete easily with Chilean nitrate.

GENERAL

The Society's Annual Dinner in London

The Second Annual Dinner in London will be held in the Connaught Rooms, Great Queen Street, W.C., on Friday, October 13, at 7 for 7.30 p.m., and it is hoped that a large number of members and their friends will be present. Ladies may be invited, and the cost of tickets, obtainable from the General Secretary, is 10s. 6d. each, exclusive of wines.

The Society's General Council for Canada

The following constitute the General Council for Canada for the year 1922-23:—Chairman: Prof. R. F. Ruttan; representatives of the Local Sections: Toronto, M. L. Davies, L. E. Westman; Montreal, A. R. MacLean, H. W. Matheson; Ottawa, F. J. Hambly, A. E. McRae; Canadian Pacific, A. E. Archibald, J. A. Dawson; Shawinigan Falls, R. A. Witherspoon, F. E. Dickie. The Secretary is Mr. Alfred Burton, whose address is 114, Bedford Road, Toronto, Ont., Canada.

Generation and Utilisation of Cold

This subject will be discussed at a joint meeting of the Faraday Society and the British Cold Storage and Ice Association on Monday, October 16, in the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. The Council of the Faraday Society has extended a special invitation to members of the London Section of the Society of

Chemical Industry to attend the meeting, the detailed programme of which is given elsewhere in this issue.

Proposed Institute of Paint and Varnish Technologists

It is intended to inaugurate a society bearing this title and with aims similar to those of the sister society in the United States. The functions of the proposed Institute will be to disseminate practical and scientific knowledge by reading and discussing papers to be published in a journal, to improve technical education, to form a technical library, to maintain close contact with Government departments, public and other bodies interested in the products and problems of the industry, and to promote research. Support has already been promised by a number of scientific and technical workers in this field, and members of allied organisations are invited to become members. Those who desire to attend the inaugural dinner, to be held shortly in London, or to assist in forming the Institute are asked to communicate with Mr. H. D. Bradford, 42, Ribblesdale Road, London, S.W. 16.

An International Scientific Congress in Utrecht

Under this title the *Chemiker-Zeitung* (Aug. 26, 1922) describes a meeting, held on June 21-23, of chemists hailing from England (3), United States (3), Austria (8), Germany (9), Holland (8), Denmark (4), Czechoslovakia (2), Latvia (1), Switzerland (1) and Russia (1). According to *Science* (Sept. 6, 1922), the meeting was planned not only to promote the interests of chemistry but to renew old friendships and form new ones between men and nations recently at war. Fourteen short papers on chemical topics were read and of these a paper on "Free Radicals," by Prof. P. Walden, was of especial interest. The social functions included a reception by the Dutch Chemical Society, at which an address was given by Prof. Wendt, president of the Royal Academy of Sciences, and replied to by Prof. W. A. Noyes (U.S.A.). The idea of holding the meeting was conceived by Prof. F. G. Donnan and Prof. Ernst Cohen (Utrecht); the organisation was in the hands of the last-named and two Dutch colleagues and the guests were very hospitably entertained. It is suggested that the time is now ripe for greater international co-operation among men of science.

Medicinal Plants in the Malay Peninsula

In a work on the "Minor Forest Products of the Malay Peninsula," published by permission of the Federated Malay States Government, Dr. F. W. Foxworthy, Forest Research Officer, gives lists of poisonous and medicinal plants. Large numbers of the local plants, he states, are used in native medicine, but only a few are recognised in European pharmacy. Some of the species included in the list of poisonous plants are also of medicinal value.

The list of the principal plants used locally for medicinal purposes contains no less than 343 names, and is taken mainly from an official bulletin entitled "Malay Drugs" published by Mr. H. N. Ridley in 1906. The table gives the family to which each plant belongs, the botanical name, the common name (usually the name given by the Malays), the part used, and the diseases, etc. for which the extract from the plant is used. Occasionally some plant acquires prominence because of

fraudulent claims as to its curative properties. This seems to have been the case some years ago with *Combretum sundaicum*, Miq., which was asserted to be a cure for the opium habit. A careful examination of the plant failed to reveal any just grounds for this claim.

Among the native plants of actual or potential use are the following:—

Brucea sumatrana, Roxb. (Fam. *Simarubaceæ*).—Kosum is well known as a plant useful in the treatment of certain types of dysentery.

Taraktogenos Kurzii, King (Fam. *Flacourtiaceæ*).—The seeds yield Chaulmoogra oil, which is so useful for treating leprosy. This species has not yet been found in the Peninsula, but occurs in Siam and Burma. The Malay species of *Taraktogenos* and of the related genus *Hydnocarpus* are worth investigating to see if they can be used in the same way.

Strychnos spp.—Several species are found as climbers, although none is so valuable as *Strychnos Nux-vomica*; but two of them, *S. ovalfolia*, Wall., and *S. quadrangularis*, A. W. Hill, are used as constituents of a Sakia dart poison. Fourteen species of this genus are recorded from the Peninsula.

Strophanthus spp.—These are coarse shrubs or climbers, some of which may contain strophanthin or an allied glucoside; apparently they are not used at present.

Dr. Foxworthy's publication also contains references to tanning materials, oleo resins and wood oils, fruit or seed oils, essential oils, and dye plants and dye woods. It is the second part of a work dealing with the forest products of British Malaya, the first having been devoted to trees and timbers.

Water-Hyacinth Ash as a Source of Potash

In many tropical regions the water-hyacinth (*Eichornia crassipes*) is a troublesome weed, and as removal is often necessary it has been suggested that the plants might be burned and the ashes used as a source of potash or as a fertiliser. Previous analyses of ash from India and Burma have shown the following variations in percentage composition:— K_2O 11.3–34.1; CaO 7.8–12.8; Cl 5.7–21.0; SiO_2 20.7–49.4; P_2O_5 1.4–8.2. Thus the potash content varies greatly. A sample of ash prepared in Burma was examined at the Imperial Institute and found to contain much extraneous mineral matter. About 11 per cent. of the crude ash was soluble in water, and the chief constituents of value, calculated as percentages of the original ash, were as follows:—Soluble portion: KCl 7.54; $NaCl$ 0.51; Na_2SO_4 1.56; insoluble portion: K_2O 1.51; $MgCO_3$ 4.16; $Ca_3(PO_4)_2$ 8.20. Ash similar to this sample would be suitable for local use as a potash fertiliser, the small content of phosphoric acid adding slightly to its manurial value. About 75 per cent. of the water-soluble matter consisted of potassium chloride, but extraction, though probably easy, would hardly pay, as 14 tons of ash yield only 1 ton of 80 per cent. KCl .—(*Imp. Inst. Bull.*, XIX, 4.)

Amalgamation of Tartaric-Acid Manufacturers in Italy

With the co-operation of the Banco di Credito, the three chief producers of tartaric acid in Italy, viz., the Società Anonima Appula, of Bari, the Società Industria Acido Tartarico, of Milan and Casale Monferrato, and the Società Italiana dei Derivati della Cellulosa, of Milan, have amal-

gamated to form a new company with a capital of 25 million lire.—(*Chem. Ind.*, Aug. 21, 1922.)

Belgian Trade in Artificial Silk

The production of artificial silk in Belgium averaged 2700 metric tons per annum before the war, one-half of the output being exported to Germany, which was the source of many of the raw materials and chemicals required, and only 5 per cent. consumed in the country. In recent years the exports have gone largely to the United Kingdom and Switzerland, as will be seen from the following figures of imports and exports of artificial silk and waste-silk yarn in 1920 and 1921:—

	Imports		Exports	
	1920.	1921	1920.	1921
	Metric tons		Metric tons	
Germany	0.3	1.1	9.0	1.3
Spain	—	—	1.5	0.6
France	2.9	1.4	—	1.9
United Kingdom ..	1.4	1.1	7.8	29.4
Switzerland	1.4	1.0	5.3	111.5
Other countries ..	0.05	0.001	4.7	9.0
Totals	6.02	4.7	28.4	152.7

The demand from Spain, Portugal, Switzerland and Japan is stated to be brisk, and some large orders have been received from the United States. Competition is feared from Japan, as that country can export articles manufactured from imported artificial silk at prices 40 to 50 per cent. less than those of other countries. One Belgian firm is contemplating the establishment of a factory in Japan on account of the cheapness of Japanese labour, and another company is to build a factory in France for manufacturing acetylcellulose silk under a contract made with a British cellulose company and covering Belgium, France, England and Poland.—(*U.S. Com. Rep.*, July 3, 1922.)

The Italian Beet-Sugar Industry

The area planted to sugar-beet in Italy during the spring shows a large increase as compared with the area planted last year, and this increase, together with the proposals to remove restrictions on trading in sugar and the reduction in the customs tariff on sugar, provides evidence that production now covers home requirements. Details of the area planted to sugar-beet, crop returns, and sugar output since 1913-14 are set out below:—

Season	Area planted Acres	Yield of beets Metric tons	Output of sugar
1913-14	203,402	2,749,907	305,564
1914-15	96,051	1,319,140	150,216
1915-16	127,761	1,457,571	150,396
1916-17	108,994	1,313,690	144,870
1917-18	111,504	883,038	92,624
1918-19	104,525	1,117,743	108,431
1919-20	145,075	1,800,917	167,767
1920-21	126,163	1,267,815	124,392
1921-22	180,310	1,685,000	217,532

No great extension of sugar-beet cultivation is possible in Italy, as the area of suitable land is limited and economic factors favour the production of cereals. Imports during the last six years have averaged 60,000 t. per annum (97,000 t. in 1921) and judging from the export in 1913-14, when 35,000 t. was exported out of a production of 305,000 t., from the present large population and the increased consumption, it seems unlikely that Italy will attain importance in the export trade in sugar for some time.—(*U.S. Com. Rep.*, June 19, 1922.)

Consumption of Fertilisers in Italy

During the war the consumption of fertilisers in Italy declined greatly, but improved after the

armistice, as will be seen from the following figures, showing the consumption in pre-war years, in 1919, and in 1921:—

	Annual average 1909-1913	1919	1921
	Metric tons	Metric tons	Metric tons
Superphosphate ..	973,000	600,000	850,000†
Basic slag ..	118,000	2,600	2,600†
Potash fertilisers ..	13,690	nil	1,405†
Sodium nitrate ..	45,250	18,000	32,000
Ammonium sulphate ..	29,783	13,700	22,000
Calcium cyanamide ..	8,583	20,000	16,000
Calcium nitrate ..	710*	nil	2,500†

* 1913 only.

† 1920 only.

The consumption of ammonium nitrate rose from 2000 t. in 1919 to 14,000 in 1920.—(*U.S. Com. Rep.*, Aug. 14, 1922.)

The Java Sugar Crop in 1922

The production of sugar in Java during the current season is estimated at 1,712,500 tons (932,500 t. white and 780,000 t. brown sugar), which compares with the realised production of 1,627,000 t. (900,000 t. white and 780,000 t. brown sugar) in the previous season. From this season's crop 434,500 t. of white sugar and 345,000 t. of brown were delivered during the four months April to July, 1922.—(*Ind. Tr. J.*, Aug. 24, 1922.)

Beet-Sugar Industry in Rumania

Prior to the war the nine beet-sugar factories in Rumania had an average production of 70,000 metric tons per annum, but in 1921 their output fell to 29,000 t., on account of the state of the factories and the reduced area under beet. It is estimated that, if transport facilities and fuel can be provided, the sugar-beet crop for 1922-23 will amount to 45,000 t. Producers state that the present market price in Rumania does not cover the cost of production.—(*U.S. Com. Rep.*, Aug. 14, 1922.)

The Petroleum Industry in Trinidad

During the past year this industry has been very active. There was a considerable increase in the footage drilled by the various companies, and a consequent large increase in production of crude oil; in fact, production in 1921 was the greatest in the history of the Colony—viz., 82,395,595 gallons, as compared with 72,905,947 galls. in 1920 and 64,436,632 galls. in 1919. The number of new wells drilled was 84, an increase of 17 over the previous year. In 42 of these wells oil was struck. At the close of the year 1921 twenty companies were actively engaged in the winning of oil, as against 22 at the end of 1920. The Admiralty continues to purchase considerable quantities of oil fuel; both crude oil and refined products are shipped to private firms in the United Kingdom and there is a considerable trade with the other West Indian islands.

Coca Production in Java

The cultivation of coca was introduced into Java in 1880 and the crop is now grown on 63 estates over an area of 6000 acres, usually interplanted with coffee, rubber and cacao. The first leaves may be gathered when the plants are 8 months old and mature shrubs yield 700 to 850 lb. of leaves per acre. Javanese coca has approximately the same content of alkaloid as the Peruvian product, but the basic alkaloid of the former is cinnamylecocaine, whereas that of the latter is cocaine. The export in 1920 totalled 3,755,400 lb., of which the bulk was shipped to Amsterdam. 619,000 lb. going to Japan and 24,000 lb. to the United States.—(*U.S. Com. Rep.*, May 22, 1922.)

Manufacture of Chlorate in Norway

Work was resumed at the Vadheim chlorate factory in Norway a few weeks ago and it is anticipated that the output will be from 600 to 800 metric tons of chlorate per annum. It is also intended to produce metallic sodium.—(*Chem. Ind.*, Aug. 28, 1922.)

Pine-Tar, Resin and Turpentine in Portugal

The Portuguese output of resin is estimated at 4000 metric tons per annum and of this 750 t. is consumed in the country, mainly for making paper (250 t.), printing-ink (100 t.), varnish, colours, etc. (50 t.), dyes (250 t.), pharmaceutical and other products (100 t.). Turpentine of good quality is produced in large amounts. The production of pine-tar and turpentine since 1916 has been as follows:—

	Tar	Turpentine
	Metric tons	Metric tons
1916-1917 ..	3,000	950
1917-1918 ..	4,000	4,200
1918-1919 ..	6,000	2,000
1919-1920 ..	6,300	1,800
1920-1921 ..	12,400	3,600

During the 1919-20 season the production of resin was 9000 t., which yielded 6300 t. of tar and 1800 t. of turpentine.

Esparto Cellulose in Spain

A large factory is being erected in Benalua de Guadix, Granada, at a cost of 9 million pesetas, to manufacture esparto paper and powder. Power will be obtained from the River Dilar by means of hydro-electric generators developing 4400 h.p. It is hoped that the entire production of esparto grass in Spain will be utilised shortly in the country and not exported, as it has been, largely to England, in which case the importation of cotton for manufacturing powder would be unnecessary.—(*Raw Materials Rev.*, July, 1922.)

LEGAL INTELLIGENCE

NUISANCE COMMITTED BY SMELL FROM A FERTILISER FACTORY. *The Attorney General v. The Elstree Chemical Works (1922), Ltd.*

In the Vacation Court on August 30, Mr. Justice Swift heard a motion by the Attorney General at the relation of the Barnet Rural District Council for an injunction to restrain, until trial of the action, the Elstree Chemical Works (1922), Ltd. from committing a nuisance by emitting smells.

For the relators it was stated that the defendant company manufactured fertilisers from leather, wool and felt waste at a works in Elstree, and that this manufacture gave rise to a strong odour which caused a public nuisance. On behalf of the defendant company, the nuisance was not denied, but a request was made for time in which to abate it, as the business had only been carried on by the company since March and several attempts had been made to avoid producing the smell.

The injunction was granted, but its operation was suspended for one month to enable the defendant company to abate the nuisance. The parties then agreed to treat the motion as the trial of the action, the injunction being made perpetual, subject to suspension for a month, and the defendant company agreeing to pay the costs.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for
September 14 and 21)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Australia	Sheets and rods of cbonite and brass (tender for) ..	†
Brazil	Sheet steel	290
"	Cement, earthenware piping ..	6657/F.L./ E.C.
British India	Steel	317
British West Indies, British Guiana ..	Cement (tender for)	**
Canada	Galvanised goods, iron and steel, copper, fireclay goods	264
Egypt	Chinaware	*
"	Oil, paint, varnish, soap, lamp glasses (tender for) ..	9008/F.E./ G.P.
Finland	Iron, steel, copper, brass, tin, lead, zinc	6122/F.R./ E.C.
France and Belgium	Calcined magnesite, white spirit, manganese dioxide, ammonium chloride, acetone, carbon tetra- chloride, yacca gum ..	301
Italy	Tinplate	270
"	Chemicals, colours, varnish, soap, perfumery, vegetable oils	302
Kenya Colony ..	Glass, glassware, pottery ..	225 25/T.G./ M.C.
Mexico	Semi-porcelain	319
Netherlands ..	Lubricating oils	272
"	Paper, porcelain	273
"	Iron and steel	275
"	Copper, phosphor-bronze ..	277
"	Oilseeds	303
"	Earthenware and fireclay goods	307
Rumania	Crucible tool steel	9000/N.E./ E.P.
Siam	Iron, steel, lead, brass, copper	S944 F.E./ E.C.
Switzerland ..	Caustic potash, sodium sul- phate, sodium phosphate, sodium carbonate, potass- ium silicate, liquid ammonia, formic acid, olein, textile chemicals	283
"	Emery, elemi resin, copal, tragacanth and other gums, Chinese wood-oil, rare metals and salts, wolfram ..	285
United States ..	Keene's cement, firebricks ..	312
"	Scrap metals	313
Uruguay	Electrical cable, lubricating oils, (tender for)	6666/F.L./ E.P.

† Supply Officer (Room 101), Australia House, Strand, London, W.C.2.

* High Commissioner for Canada, 19, Victoria St., London, S.W.1

** Director General, India Store Department, Belvedere Road, Lambeth, S.E.1.

TARIFF CUSTOMS EXCISE

Australia.—The text of a Memorandum explaining the provisions of the Customs Tariff (Industries Preservation) Act, 1921, designed to prevent "dumping," is reprinted in the issue for September 14.

France.—The import duty on ammonium sulphate has been suspended.

French Togoland.—The importation and sale are prohibited of "trade" spirits and harmful

essences and chemicals such as star-anise oil, benzaldehyde, salicylic ether, hyssop, and absinth, but not of pharmaceutical alcohol for medical or scientific use.

Germany.—New monopoly taxes have been applied to imported spirits, ether and its products. An Act has been passed authorising the German Government to increase the import duties or impose new import duties if the economic necessity arises, and to reduce or withdraw duties that have been increased or imposed under the new law.

Gold Coast.—The export duty on cocoa has been reduced from ½d. to ¼d. per lb.

Hungary.—Special permits are required for imports of oleic and stearic acids, dégras, pitch, resin, cement, coal-tar oils, indiarubber, certain wares of glass and enamel, zinc white, zinc gray, sal-ammoniac, liquid ammonia, sodium sulphate, sodium carbonate, and certain colours. Phosphates no longer require an import licence.

Lithuania.—A translation of the new export tariff may be consulted at the Department of Overseas Trade.

Malta.—Opium and certain other drugs may not be imported from the United Kingdom unless for legitimate scientific and medical purposes.

Palestine.—Import duties at the rate of 4 per cent. *ad valorem* have been imposed on timber, constructional iron and steel, ordinary window glass, hollow bricks, Portland, Roman, Keene's and similar cement, asbestos sheeting, but not on plaster of Paris and patent plasters having a lime basis. Samples of patent medicines may be imported free of duty.

Papua.—The duty on exports of copra has been reduced from 25s. to 15s. per ton.

Portugal.—The import duty on newsprint paper has been reduced to 0.1 milavo per kg. A law has been passed authorising the introduction of a new customs tariff comprising "maximum" and "minimum" rates.

Solomon Islands.—Revised schedules of import duties and free goods may be consulted at the Department.

South Africa.—Ferrosilicon rods are duty-free under the British preferential tariff, but pay a duty of 3 per cent. *ad valorem* under the general tariff.

Sweden.—An import duty of 1.50 öre per kg. has been applied to imported soft rubber tyres and outer covers.

United States.—A copy of the Tariff Revision Bill as passed by the Senate may be consulted at the Department.

Venezuela.—Salts of potassium and sodium, but not potassium or sodium hydroxides, have been placed on the duty-free list. The import duty on paper has been increased.

Yugoslavia.—The monopoly tax on petroleum has been increased to 400 dinars per 100 kg.

APPOINTMENT OF COMMITTEE ON SAFETY IN MINES.

—The following have been appointed to serve on a committee, under the direction of the Safety in Mines Research Board, to investigate the causes of, and the means of preventing, the ignition of fire-damp and coal dust arising from the firing of permitted explosives:—Col. Sir F. Nathan (chairman), Mr. W. Rintonl, Dr. G. Rotter, Mr. H. Walker, and Prof. R. V. Wheeler.

REPORTS

FIFTH REPORT OF THE COMMITTEE APPOINTED FOR THE INVESTIGATION OF FUEL ECONOMY, THE UTILISATION OF COAL, AND SMOKE PREVENTION. Pp. 17. London: The British Association for the Advancement of Science, 1922.

Since the publication of the last report the fuel situation has been dominated by the effects of the coal crisis of 1921, and this is illustrated by reference to the present position of the iron and steel industry which, better than any other, reflects the effects of coal prices upon production. The production of pig iron in the United Kingdom fell from 8,034,700 tons in 1920 to 2,611,400 in 1921, and that of steel from 9,067,300 t. in 1920 to 3,625,800 t. in 1921. It is particularly unsatisfactory from a fuel-economy standpoint that the present prices of coking coals and of coke offer little inducement to iron- and steel-makers to start up the coke ovens attached to their own works.

Oil Fuel Supplies.—Statistics relative to the importation of petroleum products into this country during the past five years are collected, and it is shown that whilst the home production of shale oil is very small, increasing quantities of fuel oil are being imported almost entirely from countries outside the Empire. The possible production of benzol in the gas and coking industries is relatively small, and owing to the low present cash value of benzol as a heating agent in coal gas it does not pay to extract it for use as a motor spirit. The development of a satisfactory low-temperature carbonisation process is therefore greatly to be desired. Although it is still problematical whether it would be more profitable to carbonise coal at 600° C. or at slightly higher temperatures, large-scale trials have shown that at 600° C. suitable coals will yield 7·5 per cent. of tar and 2·5 galls. of motor spirit, together with 3500 cb. ft. of rich gas per ton of coal (*cf.* Fuel Research Board Report, J., 1922, 270 r). The future of this industry depends upon the suitability of the solid residue for domestic use, and from this point of view the recent suggestions of Sutcliffe and Evans (*cf.* J., 1922, 196 r) deserve further investigation both from the technical and commercial standpoints.

During recent years there has been marked progress in the design of burners for fuel oil; the consumption of air or steam by the burners has been reduced and heavy oils can now be sprayed into furnaces under pressure alone. Research is also being directed towards rendering internal-combustion engines capable of burning even the heaviest oils. The outstanding question to-day is how to adapt heavy fuel oil for use in low-compression internal-combustion engines, so that it may replace motor spirit.

The Chemistry of Coal.—The problem of the constitution of coal continues to attract the attention of investigators notwithstanding its magnitude and complexity. The absence of a recognised nomenclature for the various coal fractions is leading to confusion, and it is felt that the time has come when chemists should agree upon this matter in conference.

Attention is drawn to the economic importance of the brown coal deposits at Morwell in Australia, and to the possibility of concentrating such fuels by a preliminary heat treatment (*cf.* Bone, J., 1921, 499 a).

Domestic Heating and Cooking Appliances.—The radiant efficiency of a modern gas fire is about 50 per cent., based on the *net* calorific value of the gas. It has been proved at South Kensington that, within wide limits, this efficiency is independent of the chemical composition and calorific value of the gas burnt, provided that the rate of heat development by combustion is kept suitably constant for a given size of fire. The recent work of Fishenden (*cf.* J., 1922, 13 r) and of Barker on the efficiency of domestic appliances is reviewed, and it is recommended that the design of types of domestic appliances using solid fuel should be reconsidered with a view to determining whether greater fuel economy can be secured without sacrifice of convenience or unreasonable increase in capital expenditure. In existing kitchen-ranges a large excess of air is passed up the flue and means should be taken to reduce this by enclosing the fire except when it is required for kitchen heating. Other improvements which should be considered are the lagging of the oven door and the provision of a separately fired boiler for the hot-water supply. In an appendix to the report Mr. A. H. Barker describes methods of determining the thermal efficiency of cooking appliances.

Steam Raising.—With a view to improving boiler practice throughout the country the attention of manufacturers and of public education authorities is called to the need for better supervision and education of boiler-house staffs. Fuel economy would also be promoted if more detailed financial and technical data relative to the production of electric power were published by the Electricity Commissioners.

Smoke Abatement.—It is concluded that abatement of atmospheric pollution would be best secured by the institution by the Ministry of Health of a national Smoke Inspectorate on similar lines to the existing Alkali Inspectorate, which has admittedly worked with beneficial results to the industry concerned (*cf.* Report of Departmental Committee of the Ministry of Health, J., 1922, 1 r).

REPORT ON THE INDUSTRIAL, COMMERCIAL AND ECONOMIC SITUATION OF POLAND, DATED FEBRUARY, 1922. By R. E. KIMENS, *H.M. Commercial Secretary, Warsaw. Department of Overseas Trade.* Pp. 48. *H.M. Stationery Office*, 1922. Price 1s. 3d.

During 1921 internal trade in Poland was decontrolled, export restrictions were reduced, protective tariffs were introduced, and measures were passed for developing agriculture. Poland has acquired extensive forest areas under the Riga Treaty, and has obtained rich mining, metallurgical, engineering, and chemical industries by the incorporation of Upper Silesia that should eventually enable the country to rank among the chief industrial States of Europe. Although agriculture has not yet fully recovered, production is increasing, and given good harvests, machinery and imported fertilisers, a large quantity of produce will be available for export in future.

The output of coal during the first eleven months of 1921 was 6,865,289 t., or 7·2 per cent. more than the total output in 1920; imports from Upper Silesia were 1,931,300 t., so that in future there will probably be a surplus for export. There were no changes in the lead, copper, potash and sulphur

industries, but deposits of pyrites containing 31 to 33 per cent. sulphur are being mined. Although statistics for the whole year are not available, it is probable that the output of iron ore, salt, and zinc has increased. Owing to Government control and high prices there has been no development in the petroleum industry, but the export of crude and refined products increased; about 53 per cent. of the capital invested in the industry is French and 44 per cent. British.

Many industries are gradually becoming self-supporting, and this may in time greatly affect the foreign trade. During the year the textile industry made a great recovery, about 75 per cent. of the plant being in working order at the end of 1921. In the metallurgical industry the output was only 20 per cent. of the pre-war production owing to lack of capital, shortage of fuel and food, and transport difficulties. All the coke required has to be imported from Teschen, as Upper Silesian coke is too poor to be used in blast furnaces. The production of pig iron was about 130,000 tons and of iron products 250,000 t.

Satisfactory progress was made by the chemical industry and production increased generally. Importation of heavy chemicals is decreasing and will be further reduced when Upper Silesia is incorporated. Foreign competition in pharmaceutical chemicals and dyes will be more difficult in future, as dye manufacture is progressing, and supplies of intermediates will be available in Upper Silesia; in certain branches local dyes competed successfully with British and German products. Nitric acid is made in two factories, the demand for hydrochloric acid is met by local production, and the output of sulphuric acid increased, although certain quantities were imported from Upper Silesia for making superphosphates. Reliable statistics for the chemical industry are not available at present, but are being compiled by certain branches of the industry. Sufficient soap is produced to supply the home market; there was no export in 1921 and importation is impossible owing to the low price of the local product. The glue and bone industry did well and attempts are being to export glue to Great Britain. Conditions in the tanning industry improved until October, but afterwards declined and stocks accumulated; a certain quantity of leather was imported from Great Britain, but this trade will probably not increase as the demand, except for high-class leathers, is more than met by local production. There is a good market for dry quebracho extract, the only tanning extract now imported. Trade depression affected the cement, ceramic, tile and brick factories. The glass industry is developing, although the quality of the products is usually very poor. Little advance was made by the starch industry, the output being still only 12.3 per cent. of the pre-war amount. The production of alcohol was slightly in excess of requirements and the sugar crop increased; it is probable that both sugar and alcohol will take an important place in the export trade in future.

The export trade during the first half of 1921 was over four times larger in volume than in the same period of 1920, mainly on account of increased exports of timber and petroleum. No official statistics of value are published, but it is believed that during the first half of 1921 the value of the exports was about 10.5 per cent. of the value of the imports. The volume of exports to Great

Britain increased by nearly 500 per cent. during the first half of 1921, compared with the same period in 1920, but the volume of imports from Great Britain has remained stationary since the beginning of 1920. The superior quality of British goods makes them popular in Poland, and they would be preferred if prices were lower and terms of payment more favourable.

REPORT ON THE ECONOMIC SITUATION OF DENMARK, TO MARCH, 1922. By R. M. TURNER, H.M. Commercial Secretary, Copenhagen. Department of Overseas Trade. Pp. 52. H.M. Stationery Office, 1922. Price 1s. 6d.

Although depression and unemployment were the outstanding features of the industrial situation in Denmark during 1921, agriculture was generally prosperous, except in the latter months of the year, when prices fell.

Nearly all the factories which were erected when prices of material and labour were high have disappeared or been absorbed in older establishments. The margarine industry, comprising 65 factories and employing 800 men and 250 women, probably suffered less than most. The output in 1920 was approximately normal at about 55,000 tons, but prices fell steadily, and exportation was small. Serious losses on stocks were incurred by the oil-crushing industry, and exports diminished, only 4700 t. of coconut oil and 5900 t. of soya oil being exported, compared with 9700 t. and 11,600 t. respectively in 1920. Vegetable oils were shipped to France and the Mediterranean, but exports to Germany decreased. Production of milk and cream was unprofitable, and both the conserving and the potato-flour industries suffered severely.

The sugar-beet harvest was not very satisfactory in 1921, and the 1920 crop yielded only 52,740 metric tons of sugar compared with 152,252 t. in 1914. Most branches of the metal industry were run at a loss, and the leather industry, which was built up during the war, had a most disastrous year largely owing to the failure of the export trade. Brick-making suffered from German competition, but the cement industry has begun to regain its former position, thanks to increased exports to South America (125,700 t. against 37,000 t. in 1920). The porcelain industry was fairly well employed, and the manufacture of technical porcelain, particularly for electrical materials, appears to be maintaining its position in the home market. Manufacturers of fertilisers suffered great losses owing to the fall in value of stocks, and other branches of the chemical industry were affected by the general depression and by acute competition from Germany.

The value of the export of chemical products fell from £397,196 in 1920 to £292,056 in 1921. The yeast and spirit industry is well organised under a single group; in 1920, 3900 t. of yeast and 3.4 mill. litres (nearly 900,000 galls.) of 100 per cent. spirit was produced. Paper manufacturers were badly hit by large importations from Germany and Finland.

Imports during 1921 were valued at £71,682,243, exports at £64,626,168, and the adverse trade balance was reduced from £63,084,112 (1920) to £7,056,075, largely owing to the decreased volume and value of the imports and an increase in the volume of many exports. The values, in Danish money, of some of the chief imports and exports (Danish produce) are given below (21.4 kroner = £1)

	Imports	Exports
	1000	kr.
Tallow, oil, rubber, resin, tar, etc. . .	83,415	23,629
Goods of rubber, tallow, oil, etc. . .	17,240	1,562
Paper and articles thereof . .	25,179	1,236
Chemical, technical articles . .	20,194	6,250
Fertilisers	60,482	2,610
Mineral fuels	145,827	4
Minerals, raw or roughly worked . .	16,893	13,338
Goods of clay, stone and glass . .	29,104	2,990
Wrought iron and iron goods . .	118,118	10,781

The value of imports of fertilisers increased by 23 million kr. to 60 mill. kr., the chief items and the respective decreases or increases (shown in parentheses) being:—Phosphate, raw, 23,104 tons (–81,253 t.); superphosphate, 52,500 t. (–3000 t.); Norwegian saltpetre, 49,200 t. (–13,000 t.); Chile saltpetre, 55,600 t. (–12,300 t.); basic slag, 445 t. (–3100 t.); potash fertilisers, 14,200 t. (+9600 t.). During a large part of the year British firms found it impossible to meet German, and difficult to meet Belgian and Czechoslovak competition. The Danish Export Association has been reorganised, and its functions have been transferred to a great extent to the Trade Information Bureau belonging to the Ministry for Foreign Affairs.

TRADE NOTES

BRITISH

Annual Report on the Uganda Protectorate

This report, covering the period April 1 to December 31, 1920, states that the general improvement which was a feature of the year 1919–20 (*cf. J.*, 1921, 396 n) was not maintained. The area under, and export of, cotton rose to 207,100 acres and 8517 tons, respectively, but only 1234 t. of coffee was exported, and cacao-planting has been practically abandoned. Cultivation of para rubber is increasing in spite of low prices; the output for the ten months was 140 t., valued at £23,767. The acreage under sugar-cane is extending, and experiments on the value of different varieties of cane and on the manufacture of “jaggree” are in progress. Flax has been grown experimentally, but it seems unlikely that the crop will give rise to an export trade. The use of elephant grass and papyrus for manufacturing paper and power alcohol is being investigated in England. A first consignment of timber was shipped in 1920 and a regular supply can now be obtained. The total value of domestic produce exported during the period covered by the report was £4,131,136, the increase of 125 per cent. over the value for the previous twelve months being due to the high price of cotton.—(*Col. Rep.-Ann.*, No. 112, 1922.)

FOREIGN

The Fertiliser Industry in France

There is a good demand for phosphatic fertilisers and several superphosphate factories have already sold most of their output, mainly to home agricultural syndicates and traders. Anticipating a rise in prices, farmers are attempting to cover their requirements for the approaching season, but buyers in southern France are at present holding back. Supplies of bone meal are still short as the demand far exceeds the supply. The demand for slag is strong and stocks are low; it is hoped that the steel-works will soon be able to supply it in large quantities and thus enable exportation to be resumed. Stocks of ammonium sulphate are exhausted and Great Britain is now the only source of importation.—(*Chem. Ind.*, Aug. 28, 1922.)

REVIEWS

WERKSTOFFE: HANDWÖRTERBUCH DER TECHNISCHEN WAREN UND IHRER BESTANDTEILE. Unter mitwirkung Zahlreicher Fachwissenschaftlicher Mitarbeiter. Herausgegeben von PROF. DR. PAUL KRAIS, Erster Band A bis F. Zweiter Band G bis R. Dritter Band S bis Z. Leipzig: Johann Ambrosius Barth, 1921. Price, £3 16s.

This compendious work owes its origin to Dr. Zschimmer, a former director of the well-known glass works of Schott and Co., in Jena, who had conceived the idea of bringing out a “Lexicon of Technical Materials.” For some reason which does not appear, Dr. Zschimmer was unable to carry out this project, and on the advice of Prof. Dr. B. Rasso, the publisher entrusted its compilation to Dr. Paul Kraus, of Dresden, who, with Dr. Groscheff, is responsible for the plan of the work. In view of the wealth of material to be dealt with it was obviously desirable to form a clear definition of what was to be understood by the term “Werkstoff,” and, for the purpose of the dictionary, this was defined to include “all natural or prepared technical substances constituting the material or material portion of a wholesale ware, no matter whether it is artificially produced or not.” Edible, potable and medicinal substances were explicitly excluded, as were plants and animals, fertilisers and feeding stuffs, cosmetics and furniture, clothes and leather work, as well as jewellery and articles of virtu. Having regard to the nature of the work some objection may be taken to certain of the limitations, but it was absolutely necessary that a line should be drawn somewhere, and the projectors of the undertaking must be held to be the best judges where to draw it.

It might be supposed that a work of so comprehensive a nature had no special attractions for the chemist. Such a surmise is very far from the truth. It is significant of the mode in which chemistry and chemical facts enter into the nature, application and use of the most widely varied substances that the book resolves itself practically into a chemical dictionary with so much of chemical physics added as may be thought necessary to complete the account of the particular substance described. The method of treatment may be gleaned from the following highly condensed account of the scheme prepared by the editor and Dr. Groscheff. Name of the substance in German: its etymology; its French and English equivalent; its chemical nature; its morphology; its thermal properties; its density; its mechanical-technical properties; its optical properties; its electrical and magnetical properties; its radio-active properties; its behaviour towards Röntgen and cathode rays; its acoustical properties; its chemical behaviour; its physiological action; its valuation by physical, chemical and technical proofs; its technological relations; its commercial applications, mode and extent of production, method of distribution and price, with information as to where it can be obtained in Germany.

The book, as stated in the preface, is not a dictionary of technology in the usual sense. It enters into no details of manufacture, although here and there bibliographical references are made, usually to German sources, where such details may be found. As regards prices the data given are in-

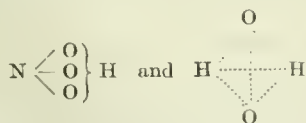
variably prior to 1914; they seem of little value, either immediately or prospectively, and have at most a merely historical interest. The same is true of the statistics of production, which are only of relative importance.

The work, like so many similar undertakings, has suffered to a great extent by the war. Its publication has been much delayed, and much of its subject-matter is already out of date. It is, however, a useful production, and contains, in concise form, a wealth of information, although certain of the data are not very recent or the most authoritative. As is usual in German publications of this kind there is a tendency to restrict the information to German sources, to the exclusion of foreign work, even when this is more recent and more accurate.

T. E. THORPE.

ANORGANISCHE CHEMIE. *Ein Lehrbuch zum Weiterstudium und zum Handgebrauch.* By PROF. FRITZ EPHRAIM. Pp. viii.+727. Dresden and Leipzig: Theodor Steinkopff, 1922. Price 21s. 6d. (bound 24s.)

Prof. Ephraim's textbook differs in many ways from others of the same size. It is more comprehensive, and the author is able by presupposing elementary knowledge, by an unusual arrangement of material, and by an admirable conciseness of style, to cover a surprisingly wide field. Compounds of the "rare" elements are considered in some detail, and the tables of physical properties also make the book valuable for reference. Recent advances, especially German, are included—even the Badische explosion of 1921! The account of Werner's theory is notably clear and detailed, and the theory of iso- and hetero-polyacids of Miolati and Rosenheim receives careful consideration. The introduction of these conceptions lights up some obscure regions—as in the case of the constitution of such compounds as 18BaO , V_2O_5 , $3\text{P}_2\text{O}_5$, 60WO_3 , $150\text{H}_2\text{O}$, but in such formulæ as



the extension of the valency conception seems almost at its breaking limit.

The arrangement of the material under the negative radicals (oxides, sulphides, carbonates, etc.), although permitting of a concise treatment, is less suitable for elementary students, since the facts then become somewhat blurred. The present book, however, is specifically written for more advanced students, and these will find it very attractive and stimulating. The arrangement is not so new as the author seems to think; it was adopted by Sir William Ramsay in the "Systematic" part of his two small volumes on "Modern Chemistry," which are masterpieces of their kind.

Prof. Ephraim has carefully avoided loose generalisation, and although the experimental details are necessarily extremely brief, he makes little use of expressions such as "breaking rings," "splitting off water," and the like, which take the place of genuine descriptive language in some textbooks.

There are several typographical errors, and one or two very questionable statements were noted, but in a book covering so much ground these are surprisingly few. The reviewer can recommend this book to all chemists as both interesting and useful. Advanced students will find it of very great value: they will discover something new on nearly every page.

J. R. PARTINGTON.

CHEMISTRY OF THE NON-BENZENOID HYDROCARBONS AND THEIR SIMPLE DERIVATIVES. By BENJAMIN T. BROOKS. Pp. 612. New York: Chemical Catalog Co., Inc., 1922. Price \$7 net.

Dr. Brooks has done well to assemble, in one volume and in systematic sequence, an orderly presentation of the non-benzenoid hydrocarbons, their properties, relationships and principal derivatives. It is a form of classification seldom adopted owing to the historically somewhat haphazard manner in which the material has been accumulated, and to the more customary, if illogical, practice of discussing the cycloparaffins and essential-oil constituents after a survey of the aromatic series has been made. Thus a wholesome rearrangement of attitude towards organic chemistry is encouraged by a study of the treatise. Moreover, the somewhat monotonous aspect of paraffin hydrocarbons as considered in earlier books is now relieved by the importance of these materials from the standpoint of the rubber, petroleum and essential-oil industries. Accordingly, the opening chapters include interesting sections on the origin of petroleum oils, the details of cracking, and recent results of oxidation. A long chapter entitled "The Ethylene Bond" embraces the modern views of Lewis and of Langmuir as applied to the carbon atom, and of J. F. Thorpe in connexion with *spiro*-compounds, followed by the work of Harries on ozonides. Alicyclic unsaturated hydrocarbons are next assembled, whilst six chapters entitled "Cyclic Non-benzenoid Hydrocarbons" deal respectively with the sub-hexyl, *cyclo*-hexane, *para*-menthane, *ortho*- and *meta*-menthane, bicyclic and tricyclic, and super-hexyl series. The concluding chapters deal with physical and physiological properties, the whole volume being well produced, agreeable to manipulate, and adequately enriched with references to recent literature.

M. O. FORSTER.

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTRY. By J. W. MELLOR. Vol. II. F, Cl, Br, Li, Na, K, Rb, Cs. Pp. vi.+894. London: Longmans, Green and Co., 1922. Price 63s. net.

The first volume of this treatise has been already reviewed very favourably (1922, 227 R), and there is no doubt that the second volume fulfils all the expectations raised by the first. In Chapter XVII, the history of the halogens, their occurrence, preparation and properties are dealt with very fully. In this and the succeeding chapters an immense mass of data is given. The language is terse, but the treatment is critical, and the author has been successful in writing a book which nowhere simulates a compilation of the dictionary type. In Chapter XVIII, in the same manner, there are described the compounds of the halogens with

hydrogen; in Chapter XIX, the oxides and oxyacids of chlorine, bromine, and iodine; and in Chapter XX the alkali metals. One of the special characteristics of the book is the completeness of the references, which are given for every statement, and appear at the end of the chapters. The number of these probably explains the absence of an authors index which, with the comparative sparseness of the subject index, is the only poor feature of the book.

Dr. Mellor is to be congratulated on the plan of the treatise and on the excellence of the first two volumes. On completion the work will fully justify the designation of a comprehensive treatise and do much to stop the present unfortunate tendency to regard inorganic and the so-called physical chemistry as separate and distinct branches of the science. The author's "Introduction to Modern Inorganic Chemistry" and "Modern Inorganic Chemistry" will form with this "Comprehensive Treatise" a uniform series of books which is unique in this or any other language. The Treatise promises to outrival the well-known German works, and is likely to be for many years the standard book for use by advanced and research students.

ROBERT H. PICKARD.

POTASH. By SIDNEY J. JOHNSTONE. *Monographs on Mineral Resources with Special Reference to the British Empire.* Imperial Institute. Second Edition. Pp. 122. London: John Murray, 1922. Price 6s. net.

This monograph on potash, like those on other mineral resources issued by the Imperial Institute, is admittedly and intentionally only a compilation. As such the monographs, when compiled with reasonable completeness and accuracy, have a very considerable value. Mr. Johnstone's monograph will take a high place in the series in this regard. He has materially added to the information contained in the first edition and produced for its size the most complete up-to-date summary of the world's resources of a material essential alike to the manufacturer, agriculturalist and chemist. Not only are the mineral resources of potash considered, but the yields resulting from animal and vegetable sources and as by-products of other industries, are also classified and discussed.

After a general statement of the world's output, the author devotes a chapter to the deposits of soluble potash minerals. His summarised account of these in Germany, France (Alsace), Spain, Abyssinia, Nigeria and Peru, to select only certain of the countries listed, is notably up to date. The succeeding chapter deals also with soluble potash, but refers to that extracted from brine, etc. from salt lakes and pans in America, Asia and Africa. Chapter IV deals with deposits of potassium nitrate of mineral origin, the South American, Rhodesian and Russian resources receiving full treatment. In Chapter VI the potassium nitrate deposits of organic origin, such as those contained in the soils of old village sites in India, South and Central America, Egypt and elsewhere, are recounted and the method of recovery described. The author advisedly devotes few words to the extraction of potash from sea-water, and passes on to the consideration of the insoluble potash minerals, alunite, feldspars, leucite, etc. The reader

is thus led naturally to the recovery of potash from the dust and gases of cement kilns and blast furnaces, where it has been volatilised from the clay, ore or fuel employed. The methods of recovery from insoluble minerals as well as flue-dust and gases are discussed, but not exhaustively, and it is perhaps not surprising to find certain notable omissions. In Chapter IX, vegetable sources of the alkali, such as seaweed, wood-ash, sunflower-stalks, bracken, and many others are described, but it is curious that the author should dismiss in a few lines the Russian supplies of carbonate which were of such extreme importance to this country and the United States of America during the war, especially for glass-manufacture and chemical needs. Residues from beet-sugar manufacture are discussed in Chapter X. An account of the animal sources of potash, such as wool-washings (suint) and karroo ash, is given in the final chapter, and the book concludes with a moderately full bibliography. The absence of an index in a compilation of this kind is unfortunate.

Finally, it may be observed that, whilst the author nowhere actually says so, and whilst he details all the adventitious sources of potash and describes the war-time expedients, he appears to regard the deposits of soluble potash salts as the mainstay of industry in the future—a point of view with which the reviewer cordially agrees.

P. G. H. BOSWELL.

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TESTED METHODS OF NON-FERROUS METALLURGICAL ANALYSIS. By S. PILE and R. JOHNSTON. Pp. 125. London: H. F. and G. Witherby, 1922. Price 7s. 6d.

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REVIEW

Vol. XLII]

OCTOBER 16, 1922

[No. 17

THE STRUCTURE OF STEELS FROM THE STANDPOINT OF COLLOID CHEMISTRY

F. C. A. H. LANTSBERRY

WOLFGANG OSTWALD has shown that there are eight possible varieties of the colloidal state :—

- (1) Solid + Solid.
- (2) Solid + Liquid.
- (3) Solid + Gas.
- (4) Liquid + Solid (suspensoid).
- (5) Liquid + Liquid (emulsoid).
- (6) Liquid + Gas.
- (7) Gas + Solid (smoke).
- (8) Gas + Liquid (fog).

Since the great bulk of metals and alloys are originally produced in the molten state it is possible for them to be obtained in the form of a molecular solution and ultimately to exist in six of the possible forms of the colloidal state.

It is well known that molten metals dissolve gases which are evolved both before and after solidification. Metals and alloys also contain slag and other enclosures, some of which become liquid below the fusion-point of the metal, whilst others remain solid well above the temperature of fusion.

Some very interesting facts are known about the solubility of gases in metals. The familiar instance of steel may be quoted, which at the moment of solidification evolves the bulk of the dissolved gas and gives rise to unsound castings. Fortunately, however, the addition of silicon in small quantities to the molten metal increases the solvent power for gases, and results in the production of sounder castings. This is quite on a par with the protective action of certain colloids. This view is confirmed by the fact that elements, such as silicon, titanium, and aluminium, whose compounds show a distinct tendency towards assuming the colloidal state, have the greatest effect in promoting soundness in steel.

The existence of non-metallic enclosures in steel is of great importance, and provides a subject about which very little is really understood. For the purpose of this note these enclosures may be divided into two classes :

(1) Those which are solid above the temperature of fusion of the steel (certain slags and alumina).

(2) Those which have a melting-point below that of the steel (sulphides).

Confining our attention for the moment to the liquid state, it is fairly certain that at some temperature the materials of the first class will become molten, so that whatever is said of the second class will be true of the first up to the point at which solidification of the enclosures commences. In any case the quantity of slag existing in steel is very minute and might almost be neglected entirely for the purpose of this note.

The influence of sulphides, however, is of very great importance, so much so that sulphur has been a nightmare to the steelmaker for generations. It is known that sulphur in excess of 0.08 per cent. tends to make steel "hot short." Another interesting fact is the change in character of the enclosures when even a small quantity of manganese is added to the steel. In an alloy containing no manganese the sulphide exists as a yellowish enclosure, but the presence of 0.2 per cent. of manganese changes the colour to a pale bluish-gray. It is fairly certain that in a steel containing no manganese the sulphur exists as ferrous sulphide, but that in a steel containing 0.5 per cent. manganese and 99 per cent. iron the sulphur should exist as manganese sulphide (MnS) is very difficult for the chemist to understand. But whatever may be the exact composition of these sulphide enclosures, it is quite certain that they may give rise to troubles in manufacture quite apart from the "red shortness" about which there is considerable exaggeration, because bars containing over 0.1 per cent. sulphur can be hot-rolled into quite small bars. The sulphide areas when segregated into large masses may cause considerable wear of tools in machining operations. This is illustrated in Figs. 1 & 2, which represent steels that are not materially different in sulphur-content, but whereas the steel illustrated in Fig. 1 caused so much wear of the tools as to be practically unmachinable, that illustrated in Fig. 2 machined quite sweetly and produced articles showing an excellent finish. The essential difference between the two lies in the

size of the sulphide enclosures. In passing it may be remarked that this is the main difference between English and American machining steels. It would therefore appear to be of considerable technical importance and of extreme scientific interest. In the first place it is known that the sulphides are insoluble in steel below its melting-point, or at least that the solubility is not greater than required to fulfil the theoretical concept that complete insolubility is impossible. It is also certain that there is no tendency for the sulphide enclosures to segregate at temperatures below the melting-point of the steel. Our knowledge of the behaviour above the melting-point of the steel when both constituents are liquid, is not even so extensive. At temperatures immediately above the melting-point of the steel we know that there is little or no mutual solubility, a point which is proved by the tendency towards segregation in the casting of large masses. At the same time we have the fact of the enormous variation in size of the sulphide enclosures in steels of various origin. This is undoubtedly brought about to a considerable extent by the extreme agitation which occurs during the various processes of manufacture.

But we have no knowledge of the solubility relationships of steel and sulphides in the liquid state. In the case of phenol and water we know that at the ordinary temperature these two materials are practically insoluble, but as the temperature is increased so the mutual solubility increases until at a certain temperature (depending upon the relative proportions of the constituents) complete solution occurs. On cooling complete solubility persists until the same critical temperature is reached, when the mixture becomes opalescent. At this point it can easily be proved that the phenol has assumed the colloidal state, but as the temperature is lowered coagulation occurs, until finally the mixture separates into two distinct layers. It is quite possible that at high temperatures steel and the sulphides show a similar behaviour, and if this be correct we have at hand a possible means of controlling the size of the sulphide enclosures and so rendering them innocuous. It is true that we cannot apply the ultramicroscope to the study of these problems, but during the last few years methods have been developed of studying the electrical conductivity and viscosity of molten metals and alloys, and this gives us a ready mode of attack, for both these properties show very definite characteristics when the colloidal state is attained.

The relations existing between carbon and iron are very interesting when regarded from the colloid point of view. Carbon exists in steel as a carbide of iron, Fe_3C , known as cementite. At all temperatures below 680°C . the limiting solubility of this cementite in iron, known metallographically as ferrite, corresponds to about 0.04 per cent. carbon. On heating, no change takes place in these solubility relation-

ships until a temperature of 700°C . is attained, when the cementite suddenly goes into solution in the ferrite. At this temperature the solution occurs in the pearlitic portions of the steel, and as the temperature is increased the solid solution produced dissolves either ferrite or cementite according as one or other constituent is in excess. If ferrite is in excess the concentration of the solid solution decreases with increase of temperature, but when cementite is in excess the concentration increases until a maximum is attained at a concentration of 1.7 per cent. carbon and a temperature of 1135°C . We see, therefore, that in steels the stable condition at high temperatures is that of a solid solution, whilst at low temperatures this solid solution has split up into its constituents, the ultimate stable condition in the cold being undoubtedly iron and graphite. During this splitting up the solid solution passes through several very definite transition stages which can be trapped and subjected to microscopic examination. The solid solution austenite is shown in Fig. 2. Apart from the polygonal outlines which are characteristic of single-phase alloys, the material is structureless. In pure carbon steels it is exceedingly difficult to obtain this structure, but by etching at high temperatures the structure has been developed. (Fig. 3.)

The normal structure obtained by properly quenching steel is shown in Fig. 4. This characteristic structure is known to metallographists as martensite, and its peculiar appearance has been ascribed to surface stress marks by some authorities and by others to the effects of twinning along the octahedral planes. By less drastic quenching or by reheating at about 400°C ., a very dark etching constituent appears known as troostite (Fig. 5), whilst still less drastic quenching or more tempering gives sorbite (Fig. 6).

If the quenching be omitted and slow cooling adopted pearlite is obtained; the structure of this material is shown in Fig. 7. By very slow cooling indeed the two constituents segregate completely and cementite and ferrite are obtained side by side (Fig. 7). Examined from the point of view of the colloid chemist these changes may be explained as follows:—

Cementite is regarded as the dispersed phase and ferrite as the dispersion medium. At high temperatures the degree of dispersion is great enough to produce the molecular solution austenite. As the material cools a temperature is reached at which the dispersed phase assumes the colloidal state and troostite is obtained. Troostite shows a maximum solubility in acids and is irresolvable even under the highest powers of the microscope. Troostite may, therefore, be rightly regarded as a colloidal solution in which cementite is the dispersed phase. As the temperature falls the phenomenon of coagulation occurs and sorbite is produced. Examination of sorbite under the



FIG. 1.



FIG. 2.



FIG. 3.

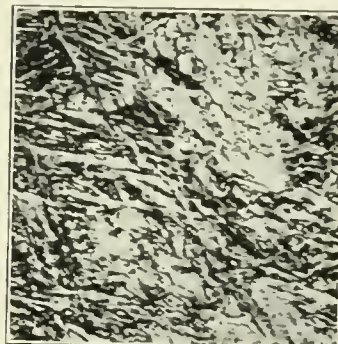


FIG. 4.

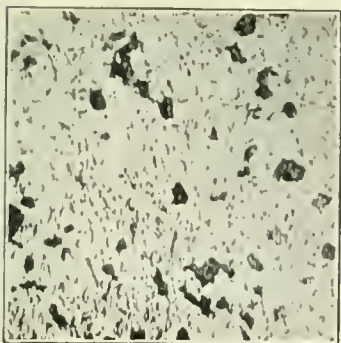


FIG. 5.

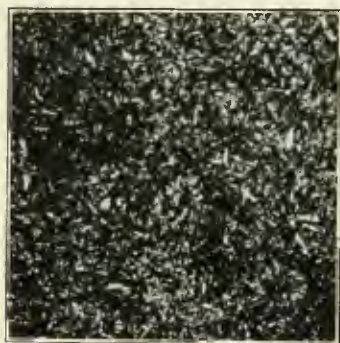


FIG. 6.

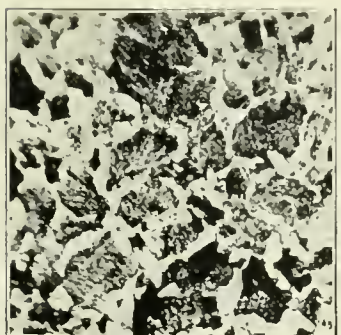


FIG. 7.



FIG. 8.

microscope indicates that it has the structure of a suspensoid. On still slower cooling pearlite is obtained and the structure recalls very strongly the phenomenon of periodic precipitation. Fig. 8 shows the Liesegang rings obtained by the precipitation of silver chromate in gelatin. These recall the appearance of pearlite in a very striking manner. We see, therefore, that colloidal chemistry gives an explanation of the reason for the peculiar laminated structure of pearlite, an explanation which will hold good for all other eutectics. It is unfortunate that the ultramicroscope does not lend itself to the study of alloys, but as pointed out earlier, other methods are available, and no doubt advantage will be taken of them in time to find out if that which at the present time is merely conjecture can be demonstrated by experiment.

THE "THERM" SYSTEM OF CHARGING FOR GAS

SIR WILLIAM POPE

AS the result of a view expressed by the Fuel Research Board some years ago, the Gas Companies now sell gas by the "therm"; the consumer is thus charged at a fixed rate for each 100,000 British Thermal Units obtainable by burning the gas. Since coal gas is used as a source of energy, it seems but just that it should be sold on an energy basis, and that its cost should be fixed by reference to the amount of some form of energy, such as heat, obtainable from it; the heat unit of a therm is quite a suitable one to use.

The new method of charging for gas replaces the former one in which a charge per 1000 cubic feet was made; to charge for gas by volume, without defining its heating value, is just as reasonable as it would be to sell milk by the pint without limiting the amount of water which might be added to it before the sale. That it is more rational to charge for gas by the therm than by the 1000 cubic feet is not to be doubted. To-day, however, the daily Press—and notably the *Daily Mail*—is said to be inundated with complaints to the effect that the new mode of charging for gas has resulted in an increase in the gas bills and in an illegitimate profit to the producing companies.

Whilst entirely agreeing that to charge by the therm marks a distinct advance, I am inclined to think that the gas undertakings have made a most unfortunate choice of the time at which to make the change. The rising coal market and the heavy expense caused to the gas-making industry by the coal strike of last year greatly increased manufacturing costs. Whilst the selling price of gas is now undoubtedly falling throughout the country, it is fairly certain that in most cases the price is higher to-day than it should be; the consumer of gas, who often understands neither the volume nor the energy unit, will not be content until the

sum total of his gas bill *in money* approximates more nearly to pre-war figures.

The attempts which have been made to popularise the therm by public advertisement have probably not served their purpose because the announcements are couched in terms incomprehensible to those who have not received the rudiments of a scientific education. It has been stated recently in the literature of gas technology that modifications are now being made in the existing gas-meter register so that the gas user may read his consumption directly in therms; this will be better appreciated than long dissertations explanatory of the therm. It might even be well if, until this modified register is universally installed, gas undertakings were to indicate upon their gas bills the consumption not only in therms but also in cubic feet, so that the public could make direct comparisons with their gas accounts of previous quarters; this would obviate the need for a calculation the nature of which is not universally understood. Naturally, it should be insisted that equal prominence is given to the number of therms and of cubic feet, and to the cost of each of the two units, the therm and the 1000 cubic feet.

Gas legislation of 1920 may have been faulty in defining the methods by which standard basic prices, dividends permissible, etc. are to be fixed, but upon this aspect of the question I am not prepared to write. It is of the greatest importance, however, that the progress made by the Fuel Research Board, in instituting the sale of gas upon a heat basis, should not be prejudiced by extraneous factors; it seems highly desirable that the Board of Trade should call for an inquiry into the question for the purpose of defining the nature of those factors which have arisen fortuitously but which undoubtedly operate against the popularity of a distinct advance, that, namely, of securing by legislative action the merchandising of gas on the basis, not of its bulk, but of its usefulness to the consumer.

* * *

In a letter to *The Times* of October 7, Sir George Beilby, Director of Research to the Fuel Research Board, explains the reasons which induced the Board, after devoting a year and a half to the study of the question, to recommend the adoption of the thermal system of evaluating coal gas. He states that there are two other matters of importance to the consumer which have not been sufficiently considered, viz., the need of a calorimeter, now available, to record continuously and automatically the heating quality of the gas, and the necessity for securing that the consumer shall burn his gas in the most economical manner. For this purpose it was recommended that the gas companies should readjust consumers' burners free of charge, whenever the calorific value of the gas was changed.

GENERATION OF STEAM BY ELECTRICITY*

F. T. KAELIN†

THE purpose of this paper is to bring before the engineering profession the conversion of electric energy into heat energy by means of an improved and inexpensive apparatus, the electric steam-generator. To produce steam by electricity appears at first sight a reversal of common-sense, but this process has its economic *raison d'être* in the fact that it can utilise hydro-electric power that would otherwise be wasted. In times of business depression the engineer is forced to consider all kinds of improvements, such as increasing efficiency of production, elimination of waste in material, labour and power; and the electric steam-generator is a handy and simple means of contributing toward this end. There are more than 300 installations in Italy, Switzerland, Sweden and France, and a small number of generators has been in use for a short time in Canada and the United States.

The low cost of the electric steam-generator compared with that of other electrical plant for converting electricity into heat, and the comparative cheapness of the wiring and control apparatus necessary, are very favourable considerations. It can be shown that even when the load factor is comparatively high, *e.g.*, in pulp and paper factories, which purchase big blocks of power and consume it, mainly for pulp-grinding, during only six days of the week, it is economically feasible during the seventh day to turn the power into steam, which is always required either for heating or manufacturing.

In the electric steam-generator the electric current passes through a resistance either of metal or formed by the water to be evaporated, and all electric energy is converted into heat energy. One kilowatt-hour is equivalent to 3412 British Thermal Units; the total heat content of 1 lb. of steam at an absolute pressure of 150 lb. per sq. in. is 1193 B.Th.U.; assuming the temperature of the feed water to be 150° F., the total heat to be supplied will be 1193—(150—32) = 1075 B.Th.U. One kilowatt-hour will therefore produce 3412/1075 = 3.17 lb. of steam. The heat losses are very small.

During the past ten years generators have been made with capacities up to 1000 kw., and only within the last two years have sizes of 2000 kw. or more been constructed.

There are two main classes of electric steam-generators: (a) those in which the current passes through a combination of metallic resistors, and (b) those in which the water itself forms the resistance. In (a) the resistors in the form of wire and ribbon made of some high-

resistance alloy may be mounted in tubes similar to those of fire-tube boilers. The arrangement allows the use of alternating or direct current, as the heating elements do not come into direct contact with water; in all other cases in which the resistors are in contact with water and the current passes partly through metallic resistors and partly through water, only alternating current can be used because direct current would decompose the water.

Generators in class (b) are built on an entirely different principle. The electric current passes through steam-tight insulating bushings to a system of stationary electrodes partly submerged in water, the water to be evaporated serving as the electric resistance. The outstanding advantages of this type are its simplicity of construction, compactness, easy control, and very low cost per kilowatt capacity. Practically any water that is satisfactory for ordinary boilers is also suitable for the electric steam-generator. The resistance of water has a negative temperature co-efficient, *i.e.*, the resistance decreases as the temperature and pressure increase. The writer has made many tests to determine the relationship between resistance and temperature for various kinds of water, and has used apparatus specially constructed for currents up to 10 amperes and 6000 volts. at atmospheric pressure. Fig. 1 shows a set of curves giving the relation of temperature and resistance for raw water from

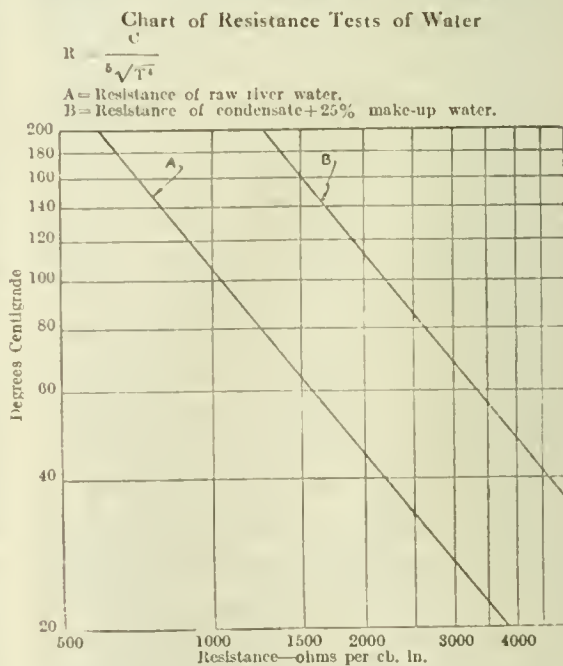


FIG. 1

the St. Maurice River and for condensate water mixed with about 25 per cent. of raw water from the same source

Using a logarithmic scale, the curves appear as straight lines, and in many other tests, of

* Abstract of a paper read before a joint meeting of the Montreal Section of the Society of Chemical Industry, the Engineering Institute of Canada, and the Institute of Mining and Metallurgy, at Montreal, on Jan. 10, 1922 (*cf.* J., 1922, 94 R.).

† Chief Engineer, Shawinigan Water and Power Co.

which the results are not shown in the diagram, it was found that these lines were all very nearly parallel. This would indicate that the same general law applies to all kinds of water. The curves have been verified above $100^{\circ}\text{C}.$ by tests on steam-generators under pressure.

Figure 2 shows a section of a 5000 kw. generator, consisting of a vertical cylindrical tank with an extension at the bottom. The

Electric Steam Generator
Three-phase single unit system

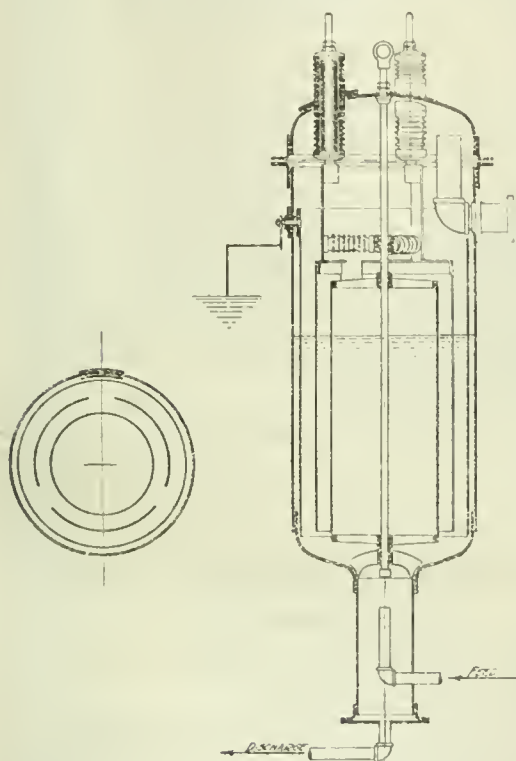


FIG. 2

upper part is flanged, and to it is bolted a dished cover which contains three openings for the porcelain bushings that insulate the three copper conductors leading to the electrodes.

The insulator bushing consists of three parts: two corrugated sleeves, one of which is outside and the other inside the tank, and a tube inside these sleeves, the whole being held together by the shoulder and nut of the conductor passing through. The arrangement shown in Fig. 2 is for 1300 amps., 2200 volts, 3-phase, 60 cycles, and for a working pressure of 165 lb. per sq. in.; the electric current passes through from both sides of the electrode to the inside and outside cylinders, and to a much smaller extent directly from electrode to electrode.

This type of generator requires but little floor space; the 5000 kw. generator with electric control apparatus can easily be placed in an area 10×12 ft., and the 18,000 kw. generator, equal to 1800 boiler horse-power, with all its

accessories, needs a ³ floor space of about 15×22 ft., and a head-room of 25 ft. for ease in dismantling.

As the heat in the steam-generator is produced in the water, there are no parts subjected to a higher temperature than that of the steam; hence no dangerous stresses are produced by temperature differences. Another element of safety is that interruptions to feed-water supply can be easily met by shutting down the generator. The operation of the electric steam-generator is at least as safe as that of the coal-fired boiler.

PHOTOSYNTHESIS

The following is a short report of the discussion on Photosynthesis which took place at a joint meeting of Sections B (Chemistry) and K (Botany) at the recent meeting of the British Association in Hull. Prof. H. H. Dixon, President of Section K, presided over a large attendance.

In opening the discussion, Dr. F. F. Blackman said that he proposed to deal with the active system of photosynthesis and its organisation in the living cell, and bring together evidence which supported the thesis that here we had to do, not with a simple photochemical reaction, but with a complex system in which other components, that might be described provisionally as protoplasmic components, played an essential part.

The first point developed was that there were numerous lower plants which obtained all their carbon by the reduction of carbon dioxide in the dark without the intervention of radiation, and synthesised all their organic compounds from that source; instead of radiant energy, there was utilised the chemical energy of the oxidation of nitrogen, sulphur, and hydrogen, or their compounds. In those chemosynthetic organisms there was not a gain of energy, but only an exchange of oxidation potential: the gain to the organism was substance for growth. It might be asked whether this power was entirely absent in the higher plants, and what connexion the chemical machinery of it had with the chemistry of photo-reduction of carbon dioxide.

The second point was the fact, now thoroughly investigated, that the seedlings of many plants at a stage when they have developed chlorophyll to a full green colour might be quite incapable of reducing carbon dioxide in light, and gave out as much of that gas from respiration in light as in dark. Some other component or property lagged behind the chlorophyll in its development and the slow, steady rate of its development was the same in darkness or light.

A third point of interest was the efficiency of photosynthesis in the golden-leaved varieties of certain shrubs. Here the amount of chlorophyll might be as low as 4 per cent. of the normal green form, and yet under medium conditions the reduction of carbon dioxide might be as great as in green leaves. The fact had been established that the golden leaf needed more light than the green to carry out the same rate of reduction of carbon dioxide. It looked as if with these extreme variations of chlorophyll what counted was the cube root of the amount of chlorophyll present—a single dimension

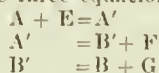
of the colloid *micellae* and not the total mass—which might be taken as an indication of the organisation of the system.

A fourth point considered was the relation of photosynthesis to temperature. It was established that for a high rate of photosynthesis it was not sufficient to have intense radiation and concentrated carbon dioxide, but a high temperature was also essential. For each temperature there was a specific maximum of activity which could not be exceeded unless the temperature was raised. The specific maximal values increased rapidly for rising temperature and had a temperature-coefficient of about 2 for a rise of 10° C. This temperature relation was quite different from that of a pure photochemical reaction, and it provided a further indication that we had to deal with a complex system in which dark reactions played a controlling part.

The fifth point to be raised had to do with the organisation of the active system. Prof. Warburg had been investigating the action of the narcotic phenylurethane upon the rate of photosynthesis and had found that the process underwent great depression of rate with perfect recovery on removal of the narcotic. The relation of the depression to the external concentration of the drug gave a typical adsorption isotherm indicating that the narcotic acted by adsorption on a surface from which it displaced temporarily some reacting substance of the active photosynthetic system.

Taking all these pieces of evidence together, we were forced to conclude that the chloroplast contained an active system of several components related together in a complex organisation.

Prof. E. C. C. Baly said that the conversion of a substance A into substance B might be represented as the sum of the three equations:—



where E, F and G were quantities of energy and A' and B' represented the reactive forms of A and B. The reaction was exo- or endo-thermic according as $F+G-E$ was positive or negative. In any case a quantity of energy, E, must be supplied in order to start the reaction, and this might be done by means of (i) heat, (ii) light, or (iii) a material catalyst. The energy could only be supplied in "quanta," and if E were large only the use of a radiation of short wave-length made the number of quanta to be introduced sufficiently small to be practicable. For the conversion of a molecule of carbonic acid into formaldehyde and oxygen, 150,000 calories was necessary, and this could be supplied in a single quantum by radiation at wave-length 200 μ . Carbonic acid had an absorption band at this frequency, and formaldehyde ought therefore to be produced when a solution of carbon dioxide in water was exposed to ultraviolet light. This had now been shown to take place.

In order to bring about the reaction by means of visible light, it was necessary to have present a coloured substance with basic properties, and Malachite Green had been found to fulfil the conditions. There seemed little doubt that the formation of formaldehyde in the leaf proceeded as follows:—

- (i) $[Chl.A + H_2CO_3] + \text{light} \rightarrow [Chl.B + CH_2O]$.
- (ii) $[Chl.B + Carotin] \rightarrow Chl.A + \text{Xanthophyll}$.
- (iii) $\text{Xanthophyll} + \text{light} \rightarrow \text{Carotin} + \text{Oxygen}$.

The photosynthesised formaldehyde was extraordinarily reactive and was best represented by the formula $CHOH$. It polymerised rapidly to a

mixture of carbohydrates, in which were found hexoses, and evidence was not wanting in favour of the formation of more complex substances. In the presence of nitrite it was converted into form-hydroxamic acid, and hence into amino-acids and a mixture of cyclic bases in which piperidine, pyridine, coniine and glyoxaline had been detected. The active (energised) forms of the amino-acids condensed with the cyclic bases to give substituted amino-acids, and these were the immediate source of proteins.

Mr. G. E. Briggs described some experiments to determine the relation between the radiant energy absorbed and the carbon dioxide assimilated by the green leaf (*Phaseolus vulgaris*) in different parts of the visible spectrum. For three different parts of the spectrum the carbon dioxide assimilated was measured, and the energy absorbed by chlorophyll *a* and chlorophyll *b* was estimated from data obtained, due allowance being made for the energy diffusely reflected by the leaf. The results were of the following order:—For the yellow-red (570–640 μ) 15 calories per c.c. of carbon dioxide; for the green (510–560 μ) 7; and for the blue (430–510 μ) 22+, these being maximal values. Since the heat of formation of the most probable products of assimilation ranged from 5 to 6 and more calories per c.c. of carbon dioxide it was probable that both chlorophyll *a* and chlorophyll *b* took part in the photochemical reaction.

Referring to Prof. Baly's suggestions as to the part played by the different pigments in the photosynthetic process, Mr. Briggs said that as the quantity of each pigment underwent relatively little change during prolonged assimilation, no energy was supplied from that source; and, further, that since as much oxygen was evolved as carbon dioxide was absorbed in the red and the green parts of the spectrum (regions where no energy was absorbed by the xanthophyll) as well as in the blue, it was not necessary to postulate a photochemical reaction involving xanthophyll in order that oxygen might be liberated.

Prof. I. M. Heilbron and Mr. C. Hollins put forward some speculations on phytosynthesis. The large number of plant products in which the predominant carbon nucleus was C_6 or a multiple of it suggested that this unit had a special significance. The photosynthesised reactive hexose might be supposed, in addition to its further condensation to sugars, cellulose, glucosides, etc., to furnish by dehydration ω -hydroxymethylfurfural. This by oxidation and decarboxylation could give a stabilised C_5 -compound, which, either as the furan derivative or (by opening of the ring) as dihydroxyglutaconic dialdehyde, might be a source of pentoses and of their condensation products. Simple schemes were suggested to show how two, or three, molecules of a "pentose" could give rise, by ordinary condensation reactions, to anthocyanins (C_{15}), terpenes (C_8 , C_{10} , C_{15} , etc.), coniferyl alcohol (C_8) and the numerous related compounds (including lignin), coniine (C_8) and the phonopyrrole-carboxylic acids (C_8 , etc.). The degradation of hexose into "pentose" represented the respiration of the plant. Against the suggestion of Robinson (British Association, 1921) that anthocyanins resulted from the condensation of two hexose and one triose molecules were to be set the absence of nonoses in nature and the failure of all attempts to obtain benzene derivatives from hexoses.

Prof. R. Robinson thought that the accumulation of active formaldehyde and formhydroxamic acid scarcely accounted for the almost inexhaustible variety of plant products. The alkaloids were probably produced from hexoses rather than built up atom by atom from formaldehyde. He was unable to accept the suggestions of Prof. Heilbron and Mr. Hollins as to the significance of the C_5 -unit. Practically all the compounds in C_{5n} belonged to the terpene family and were derivable from isoprene. Apiose, the sugar corresponding to isoprene, was a simple condensation-product of dihydroxyacetone and glycolaldehyde. The anthocyanins he preferred to consider as $C_6+C_5+C_6$ rather than $C_6+C_5+C_3$. Although nonoses had not been found in nature, Emil Fischer had obtained a nonose which was fermentable.

Dr. E. F. Armstrong emphasised the fact that cane-sugar was the first sugar formed in the plant. If hexoses were produced immediately their existence was but transient.

Prof. Baly, in reply to the discussion, said that Mr. Briggs' experiments, though valuable, could not be interpreted quite so simply as was assumed. The relation between radiation absorbed and quantity of reaction resulting was very complex, and, indeed, in only one case so far (*viz.*, the conversion of oxygen into ozone) was the Einstein theory satisfied. The measurement of photochemical efficiency was thus an abstruse problem and the experimental results were far from justifying Mr. Briggs' conclusions concerning the individual rôles of the leaf pigments.

NEWS FROM THE SECTIONS

MANCHESTER

The new session of the Manchester Section was inaugurated on October 6 by an address given by the President of the Society, Dr. E. F. Armstrong, on "Practice and Theory in an Industrial Problem." Dr. E. F. Arden, chairman of the Section, presided over a large attendance. An abstract of Dr. Armstrong's remarks is given below.

The main object of my remarks is to illustrate to you the extreme breadth of chemical problems, and the necessity for breadth both in the training and in the mind of the chemist if he is to succeed in his profession. The illustration I have chosen is that of the hydrogenation of fats. The difficulties encountered by Sabatier, Normann and other early workers in this field demonstrate the hundreds of ways in which the chemist has to exercise his ingenuity; how he has to be master of all trades, and how considerations of all kinds, in addition to those of the text-book equations, enter into his daily life. Twenty or twenty-five years ago nobody knew how to make pure hydrogen in quantity and cheaply. Therefore the would-be hardener of fats had to find out how to make hydrogen. Electrolytic hydrogen naturally appeared attractive, but the costs of the plant, the prime costs, and the lack of any outlet for the oxygen ruled it out of court. Alternative fancy methods, *e.g.*, the action of acids on iron, also broke down on the grounds of cost; and the only method which to the manufacturer seemed to promise success was that of

removing carbon monoxide from water gas. Now, even the manufacture of water gas in those days was in a very crude state. You could buy producers, but the life, the cost of repairs, and so on, left much to be desired. Therefore the would-be carrier-out of the chemical process found, in the first place, that his energies were dragged right back to what was almost a gas-engineering, at any rate a chemical-engineering, problem of his producer plant. The many and great difficulties connected with this problem were originally solved, more or less empirically, by hard work, the chemist on the spot making practical, careful trials, and keeping data added by the engineer. In later days the physical chemist has come to our assistance, and by a proper use of thermodynamics, etc. has done much to enable the ideal conditions of the laboratory to be foretold before they were applied to the plant. But in the main such work, valuable as it is, merely served to confirm the results which were arrived at empirically by the hard-working men on the spot. The next problem was the very important one of the cost of the hydrogen. It is worth while stopping to analyse the items which enter into that cost. There is, first of all, the actual running costs of the plant, the cost of the iron ore, the cost of labour, the cost of the heat to generate the producer gas, and so on. Then there are the repair costs, and the capital costs, interest, depreciation, rating, and so on. It is no use neglecting, in practice, any one of these costs, and every new method has to be criticised from these points of view. You may have a perfectly ideal process which will break down entirely because the plant has to be renewed once a month. We had the misfortune during the war to work a process in which the plant, otherwise ideal, had to be renewed once a fortnight; this difficulty was fatal. The electrolytic process of making hydrogen suffers from a high capital cost, unless it is carried out in a country with unlimited cheap water-power. Running costs are of considerable importance sometimes, but they alone are never determinative.

To turn now to the problems presented by the oil and the catalyst. Before fat-hardening was introduced the unsaturated oils were worth very much less than the saturated oils, and one could afford to spend quite a lot of money in hardening them and still make a lot of money from the hardening process. To-day, through some vagary of the world's markets, the unsaturated oils are worth so much in comparison with the saturated ones that in hardly a single case can one afford to spend even half the money necessary for hardening. The process is out of action through the vagaries of the market. The wise man at the head of a company will have to take a long view of past and future markets before he decides to indulge in the capital expenditure necessary to put up a plant of this sort, so that directly we are up against the cost of the oil the chemist has to turn himself into an economist, or associate himself with the economist, and think of his problem from that point of view. Of course, the actual production of the oil is outside our range, although it should be within it; because it is very much better for us to receive a carefully made, relatively clean oil, and to deal with that, than it is for us to receive a carelessly made, dirty oil, and try to put right a harm which has been done. So really the chemist's care ought to go right back to the original production

of the oil and not to come in when the oil is delivered to him. In the works the oil has to be cleaned to the maximum extent possible.

Then there remains the catalyst. Here the training of the chemist comes into play, and it is to get the catalyst in a suitable state that his skill is required. The early writers on this subject, much of the patent literature, and such technical papers as there are, of course, bring in higher mathematics and every form of modern high-class chemistry, but I think it is very much better for the practical man to approach it from the other end, that of simplicity. The active nickel surface is obtained by saturating kieselguhr with the nickel salt, precipitating with alkali, washing, and reducing the oxide to the metal. It is very simply said, but it is difficult to choose conditions which do not harm that very delicate surface. No theories are required in preserving that surface. First of all, one must use salts that can be easily washed away, nitrates rather than sulphates, for if they are not washed away they can be burnt away. The catalyst must not be overheated, because the globules of metal soften and begin to coalesce far below the melting-point. The actual problem of heating the active catalyst is purely a common-sense one which requires a great deal of thought and care. Although it sounds very easy to describe in a few words, the solution took a great many years of research to find. Then we have catalyst poisons. There is a wonderful literature based on catalyst poisons and a very wonderful jargon. It all amounts to this, that if you have anything which spoils the surface, you obviously reduce the activity of the catalyst. There is no mystery about it, it is obvious simple fact, but it has been wrapped up in a great deal of mystery. The next stage is to bring together the cleaned oil, the purified hydrogen, and the clean catalyst under suitable conditions. We must have chemical control in order to be able to stop at any particular point. The reaction takes place quite fast, and a good many tons of material are worked up at a time. You cannot see when the oil has attained a certain hardness, so you have to take it out and test. The determination of hardening-value takes some time; the determination of the melting-point takes a long time; the determination of the refractive index is the only quick method, and the melting-point may be deduced from the refractive index by means of a correlative curve.

Fats, I might say, are sold, as they always have been, on a titre. The titre has nothing whatever to do with the hardening number or the refractive index of any fat, so the unfortunate fat-hardener is never quite certain he is going to stop at the right titre. If he tries to get over this difficulty by mixing A tons of one titre a little above the mark with B tons of another titre below the mark he does not get the titre he hopes to arrive at. So the chemist has to set up a lot of very elaborate controls in order to comply with an utterly irrational selling-method based upon an archaic custom of the tallow trade. You would think these salesmen and buyers would listen to the chemist; but no, that difficulty is the only one which he is not able to solve. I quote you this, in all earnestness, as typical of British practice, and I think everyone will endorse our feeling that this is an example of some of the real difficulties with which the British nation has to contend.

Having briefly sketched the practice, I will now say a little about the theory of this reaction, because it also brings in every branch of chemical affairs. There are at least two theories to explain why a reduction takes place. One theory is that adsorption of hydrogen occurs at the surface of the nickel. I do not know what adsorption means, but in some mysterious way it is supposed to provide the active hydrogen which brings about saturation. The other theory is that combination between nickel and oleic acid is brought about through partial valencies and that then the unstable complex breaks down. We have a beautiful experimental proof of the formation of such a complex, and the investigations of Rayleigh, Hardy, Adam, and Langmuir, all tend to support the additive-compound theory.

It is hardly necessary to say that such work as I have been describing is the result of team work. Team work is only possible where there is loyalty, self-sacrifice, and good feeling, and I am quite certain that British industry needs work of this kind. My experience, limited as it is, has left me with a feeling that the very training we chemists get, the analytical training, i.e., the training of suspicion, has made us much less ready to mix together, much more critical of our fellow chemists, than is desirable in the best interests of the profession. I think the greatest good this Society has been doing, is doing, and can do, is to keep on bringing us together to discuss problems in the most friendly way possible, so that members may learn what is both in and at the back of one another's minds.

MEETINGS OF OTHER SOCIETIES

THE IRON AND STEEL INSTITUTE

The autumn meeting was held last month in York under the presidency of Mr. Francis Samuelson. In a paper on the bases of modern blast-furnace practice, Mr. A. K. Reese defined the object to be sought as the attainment of the greatest possible quantity consistent with quality, a statement demurred to by Prof. H. Louis, who maintained that the aim should be the greatest possible economy consistent with quality; economy and quantity were not always associated. The paper was very comprehensive, treating the subject from four aspects: (1) preparation of materials, (2) furnace design, (3) auxiliary equipment, and (4) method of operation. Under (1) the author emphasised the need of perfect uniformity in the size and density of the materials charged; under (2) that the output capacity of a blast furnace is proportional to its effective bosh area; and under (3) the importance of rough-cleaned gas and regularity in the volume of its admission.

Mr. C. W. H. Holmes described an investigation of the factors influencing the grain and bond in moulding sands, the factors being the various processes to which such sands are subjected, and the properties investigated being the strength of the bond and the ratio of the mechanical grades of sand. Mr. L. E. Benson related how he had nitrogenised specimens of "armco" iron and steels by annealing them at 500° C. in a salt bath containing 17 parts of sodium nitrate to 3 of potassium chloride, the rate of absorption of nitrogen being about 0.02 mm.

per hour in the case of "armco" iron. In answer to criticism, he stated that there was no positive evidence that a nitride was formed.

The results of researches carried out in the laboratories of Vickers, Ltd. were described by Mr. J. H. S. Dickenson in his paper on the flow of steel at red heat and the sealing of heated steels, a subject of especial interest to makers of steel apparatus, such as that used in synthetic-ammonia production, which has to withstand high temperatures and pressures for long periods. The author has determined that temperature at which the rate of flow of a steel does not exceed a practically negligible amount when subjected to a uniform stress of 8.5 tons per sq. in. A graph was shown comparing the results of tests applied for periods varying from a few seconds to many weeks, and another which emphasised the very great influence of time in determining the maximum temperature at which a steel can support a given load, and therefore also the load which the steel can bear at any temperature.

In some practical notes on the manufacture of high-speed steel in the basic-lined electric furnace, Mr. H. K. Ogilvie stated that at Coventry the use of ferro-tungsten was preferred to that of tungsten powder, and that the use of high-speed turnings as raw material for the furnace was found to be uneconomical. Other papers presented were:—"On the Diminution of Lag at Ar1 through Deformation": J. H. Whiteley; "Changes in the Volume of Steels during Heat Treatment: (1) Air Hardening Nickel-Chromium Steels": L. H. Aitchison and G. R. Woodvine; "Magnetic Properties of Heat-treated Carbon Steels": E. D. Campbell and E. R. Johnson; and "A Brinell Machine Attachment": E. D. Campbell.

At the annual meeting to be held in London, in May, 1923, a resolution will be submitted to alter the period of office of presidents from two years to one year.

THE INSTITUTE OF METALS

Swansea, the metallurgical centre of the South-West, offered its hospitality to the members of the Institute on the occasion of its autumn meeting (Sept. 20-22), and those who took advantage of it must have been impressed by the evident desire of the local people to foster the *entente cordiale* which is springing up between the scientific and the practical pursuers of the art of metallurgy. This desire is clearly shown by the efforts which have been, and are being, made to develop the new University College on sound and broad foundations. The excellent laboratories that are being erected and equipped in Singleton Park—the gift of the Municipality—under the direction of Prof. C. A. Edwards (metallurgy), Prof. J. E. Coates (chemistry) and others: the many scholarships that are being offered to students: and the close *liaison* that is developing between the academic staff and the manufacturers—all point to the thoroughness with which the ground is being prepared and to the plentiful harvest that will surely follow. The Institute of Metals has its eye upon Swansea, and intends to form a local section there as soon as possible. The following papers were presented to the meeting:—

The Sixth Report to the Corrosion Research Committee of the Institute of Metals on "The Nature of Corrosive Action and the Function of Colloids in Corrosion": G. D. Bengough and J. N. Stuart.

The report attempts to present a general review of corrosion phenomena based on the study of several different metals, and to examine how far the electrochemical theory of corrosion can interpret these phenomena. The difficulties encountered by this theory are indicated, and it is shown that it gives a satisfactory account of the facts only under certain conditions: many facts can only be explained by recognising the important part played by colloids in corrosion. A theory of the mechanism of colloid action is put forward and some experimental results are reviewed in the light of this theory. On the electrochemical theory the action of oxygen is that of a depolariser; it can be shown that atmospheric oxygen has very little depolarising power at ordinary temperatures. Two chief types of corrosion are distinguished: (1) the general type, usually characteristic of acid corrosion, and (2) the local type, usually characteristic of corrosion in water and salt solutions. The second type is generally characterised by the formation of an adherent scale on the metal, and this scale may contain colloid.

A short Note on the Effect of Superheated Steam on Non-Ferrous Metals used in Locomotives: Sir Henry Fowler. This paper discusses the compositions of the various alloys used for the bushes in which piston tail rods slide, for piston-rod packing, and valve-spindle packings. After various experiments it was found that a phosphor-bronze (Cu 88, Sn 11, and P 1 per cent.) was most satisfactory. The composition of the McNamee rings was 70 per cent. lead, 30 per cent. antimony; this alloy gave complete satisfaction so long as the working temperature was kept below 340° C. A critical point was apparent about that temperature and the rings were liable to fuse. For by-pass valves a complex nickel-brass alloy gave successful results, but owing to the cost was replaced by castings of malleable iron or steel.

White Metals: A. H. Munday, C. C. Bissett, J. Cartland. The principal classes of white metals are reviewed, together with their composition and physical properties, chiefly in relation to their manufacture and uses.

The Effects of Overheating and Remelting on Aluminium: W. Rosenhain and J. D. Grogan. The work described was undertaken to ascertain whether certain forms of treatment in the melting and remelting of aluminium would cause deterioration approximating to the condition generally described as "burnt" aluminium. High melting and casting temperatures, and even prolonged heating at a high temperature, gave no evidence of any serious deterioration in the quality of the metal. Repeated rolling and remelting were also without appreciable effect.

The Constitution and Age-Hardening of Alloys of Aluminium with Copper, Magnesium and Silicon in the Solid State: Marie L. V. Gayler. The quaternary system of alloys containing aluminium, copper, magnesium and silicon has been regarded as the ternary system aluminium-copper-magnesium silicide, since magnesium and silicon were added in the proportions of the compound magnesium silicide. The solubilities of copper and magnesium silicide in solid aluminium were determined at 500° C. and 250° C. Alloys of various compositions were quenched from 500° C. and allowed to age-harden at room temperature. The results showed that the age-hardening of these alloys is due to the difference

in solubility at high and low temperatures of both copper and magnesium silicide. Derived differential curves of alloys which had been quenched but not aged showed three critical points. The highest critical point is suggested to be due to the precipitation of the copper compound, and the next to that of magnesium silicide.

First Report to the Aluminium Corrosion Research Sub-Committee of the Corrosion Research Committee of the Institute of Metals on Experiments on the Oxide Method of Determining Aluminium: J. E. Clenell. The drawbacks of the method for determining aluminium as oxide are discussed and improvements are suggested. Of the various methods examined, that in which thio-sulphates are used for precipitation gives, on the whole, the best results. By working according to the standard method described, a practically complete precipitation of aluminium is obtained.

The Copper-rich Aluminium-Copper Alloys: D. Stockdale. An attempt has been made to settle some of the doubtful points concerning copper-rich alloys. Two general methods of fixing the various points were used, viz., the taking of cooling curves and the micro-examination of quenched specimens. The results showed that, contrary to Curry's statement, small quantities of aluminium do not raise the freezing-point of copper. The liquidus presents a minimum at 8.3 per cent. aluminium and shows a maximum at about 12.5 per cent., though the alloys in this neighbourhood all freeze at about the same temperature, 1047° C. The solidus shows the existence of eutectic over a range of alloys containing 7.5, 8, and 8.5 per cent. aluminium; alloys with 10 to 14 per cent. aluminium exhibit cooling curves typical of pure metals. At 16.5 per cent. a second eutectic makes its appearance, whilst the 18 per cent. alloy freezes like a pure metal. The positions of the lines bounding the phase fields formed by the constituents α , β , γ have been carefully determined, and the existence of the γ phase and transformation of the γ to δ phase have been confirmed. The temperature of the eutectoid transformation, determined by quenching experiments, is near 537° C.

The Cleaning of Aluminium Utensils: R. Seligman. In the absence of the author this paper was taken as read. It dealt in general with the cause of corrosion of aluminium utensils and showed that the presence of sodium silicate prevented the corrosive action of the soda. Certain cleansers sold under trade names were recommended.

New Forms of Apparatus for Determining the Linear Shrinkage and for Bottom-pouring of Cast Metals and Alloys, accompanied by data on the Shrinkage and Hardness of Cast Copper-Zinc Alloys: F. Johnson and W. G. Jones; The Hardness of the Brasses and some Experiments on its Measurement by means of a Strainless Indentation: F. W. Harris. These two papers were taken together. The apparatus was designed to be sufficiently simple and robust in operation for use in industrial work. The motion of a shrinking test-bar is conveyed through two steel arms, gripped rigidly by the cast bar, to a micrometer, the head of which is attached to one arm and the anvil to the other. Results of hardness tests on chill cast and annealed bars in both papers are in common agreement, and show an elusive maximum. The hardness curve of sand-cast bars, as shown in Harris's paper, does not give a definite maximum hardness. The author shows that the "absolute" hardness number of a metal is given by

strainless indentations. These are obtained by repeated annealings of the metal to remove the strain round the impression and the replacing of the ball in the original indentation and again applying the load. This is repeated until the point is reached when the indentation is of sufficient superficial area to enable the metal to support the load by virtue of its own intrinsic resistance to distortion.

The Structure of Eutectics: F. L. Brady. It is shown that each eutectic grain consists of an inner portion, fine in grade and of uniform fineness, and a boundary of varying thickness, the grade of which is much coarser and of different arrangement. Two possible causes of this structure are discussed. The forms of eutectics may be divided into classes according to certain physical properties of the components; the division proposed shows the considerable connexion that exists between the physical properties, especially surface tension and the structure.

The Antimony-Bismuth System: Maurice Cook. The equilibrium diagram of the antimony-bismuth alloys is shown to consist of an unbroken liquidus curve, whilst the solidus is horizontal up to 60 per cent. antimony. The microstructures of slowly-cooled and quickly-cooled alloys reveal an apparent duplex structure which can be rendered homogeneous with sufficiently long annealing. The results lead to the conclusion that an isomorphous series of alloys is formed.

Note on the Cause of Red Stains on Silver-plated Work: A. Jefferson. The author discusses the possible origin of the red stains sometimes observed on articles electroplated with silver. Hypotheses regarding the origin of these stains were put to the test; ultimately, it was found that the application of rouge was responsible for the red stain; insufficient material at hand, however, prevented the matter being further examined.

Intermetallic Actions. The system Thallium-Arsenic: Q. A. Mansuri. In this paper the author claims to establish the facts that thallium and arsenic alloy in all proportions but do not form any solid solutions. An eutectic is formed at 215° C. between thallium and arsenic, and forms the solidus. The liquidus consists of the primary separations of thallium and arsenic, broken by a gap showing the presence of two layers of liquid.

INSTITUTION OF CHEMICAL ENGINEERS

At the thirteenth meeting of the Provisional Committee, held on September 20, the solicitors announced the receipt from the Board of Trade of a letter stating that the application for a licence to register the Institution under the provisions of Section 20 of the Companies' (Consolidation) Act, 1908, had now been entertained.

The secretary reported that over 180 applications for membership had been received, and that the names of those applicants which had passed the Selection Committee would be brought before the first Council as soon as formed.

The report of the sub-committee on the relations between the Chemical Engineering Group and the Institution of Chemical Engineers was considered and action was postponed until a later date. A vote of thanks was carried unanimously to the Registrar and Council of the Institute of Chemistry for their kind assistance in explaining fully their office organisation.

NEWS AND NOTES

UNITED STATES

The New Customs Tariff

The McCumber-Fordney Tariff Bill was signed by President Harding on September 21 and came into operation on the following day. As passed, the Bill contained no embargo on dyestuffs, coal-tar and synthetic organic chemicals, and foreign potash is to be admitted free of duty. Provision is made for increasing the duties imposed if foreign competition is shown to be injurious to a home industry. In general the rates of duty are increased by 15–20 per cent., but those on certain chemicals, metals, etc. are much higher. The following are some of the rates fixed:—Coal-tar intermediates, 7 cents per lb. plus 55 per cent. *ad valorem*; coal-tar dyes, 7 cts. plus 60% *ad val.* based on the American valuation; citric acid, 17 cts. per lb.; essential oils, animal oils and greases, ethers and esters, 20 cts. per lb. plus 25% *ad val.* The free list includes ores of tin, cobalt and copper, various crude drugs, fertilisers, potassium chloride and crude potash salts, thorium ores, sodium nitrate, sulphur, turpentine, rosin and wax, etc.

Peace-time Uses of War Chemicals

The United States Chemical Warfare Service has recently discovered that the use of hydrogen cyanide as a fumigant can be replaced by that of cyanogen chloride, which is a powerful lachrymatory when used at only one-tenth of the lethal concentration. Encouraging results are also being obtained in experiments on the admixture of a "sneezing" gas with illuminating gas as a means of detecting an escape of the latter, the sternutatory being destroyed when the gas is burned. Progress continues to be made in the use of poisonous gases against insect and rodent pests, notable work having been done recently in combating locusts in the Philippines; and attempts are being pursued to find a gas for destroying the cotton boll-weevil. Very successful experiments have been made by the Louisiana Department of Agriculture in spraying powdered calcium arsenate on cottonfields by means of the air blast from the propeller of an aeroplane; in this way it was found possible to treat 20 acres of cotton per hour much more thoroughly than by means of apparatus worked on the ground, and to reduce by one-half the amount of material needed.—(*Chem. and Met. Eng.*, Sept. 13, 1922.)

Anthrax in the Tanning Industry

An analysis of 123 cases of anthrax occurring in the tanning industry of Pennsylvania during the twelve years from 1910 to 1921 showed that the number of cases represented roughly 12 per cent. of the employees directly exposed to infection, i.e., those handling, soaking and liming raw stock. The mortality among these 123 cases was over 21 per cent. Accurate statistics for a five-year period revealed a yearly morbidity rate of nearly 2 per cent. From a study of the sources of infection it is concluded that certification (that imported hides are from districts free from anthrax) offers little if any protection to the tanner. It is therefore suggested that all undisinfected imported stock should be treated at central governmental disinfecting stations before dispatch to the tanners. Experience has shown that the best treatment consists in the continuous,

intensive use of anti-anthrax serum, applied subcutaneously or intravenously, combined with excision of the local lesion and injection of a concentrated solution of phenol (25 to 50 per cent.) around the wound. Early diagnosis, prompt treatment and rest are essential for successful treatment.—(*J. Ind. Hygiene*, June, 1922.)

Census of the Dye and Coal-tar Products Industry

The U.S. Tariff Commission has issued a preliminary summary of the census of dye and coal-tar chemicals for 1921, based on the output of 200 firms that manufacture coal-tar products. Adequate supplies of coal-tar during the year were ensured by the increased production of by-product coke, which corresponded with a smaller output from beehive ovens. The statistical information given includes that set out below in tabular form.

Coal-tar products	No. of makers	Output lb.	Inc.(+) or Dec.(−) per cent.		Sales lb.	Value of Sales \$
Intermediates (232)	107	70,899,912	—	73	33,637,326	8,483,463
Coal-tar dyes ..	74	39,008,690	—	56	47,513,762	39,283,956
Colour lakes ..	43	6,152,187	—	44	6,424,612	2,868,189
Medicinals ..	34	1,545,917	—	68	1,876,246	2,930,324
Flavours ..	17	901,245	+	440	933,662	1,002,018
Perfumes ..	15	119,335	+	20	119,691	175,815
Synthetic phenollic resins	3	1,643,796	—	65	1,674,450	1,352,166
Synthetic tanning materials	4	1,902,597	—	39	1,721,350	141,005
Research chemicals	—	2,012	+	9	901	18,334
Photographic ..	5	183,798	—	58.	170,221	248,041

The production of dyes in 1921, grouped according to methods of application was as follows:—Acid dyes 7,751,698 lb. (19·87% of the total output); basic dyes 1,852,243 lb. (4·75%); direct cotton dyes 6,787,634 lb. (17·4%); sulphur dyes 10,239,255 lb. (26·25%); vat dyes (including 6,673,968 lb. of indigo) 7,019,120 lb. (17·99%); mordant and chrome colours 3,773,438 lb. (9·67%); lake and spirit-soluble dyes 697,444 lb. (1·79%); unclassified dyes 887,858 lb. (2·28%).

Cadmium in 1921

The production of cadmium in the United States began in 1906 with a small output by the Grasselli Chemical Co., and afterwards increased steadily, reaching a maximum in 1917. In 1921 production of cadmium metal declined to 65,101 lb., valued at \$63,799, but that of cadmium sulphide attained the record of 65,446 lb., valued at \$71,336. Electroplating with cadmium by the udylyte process (*cf.* J., 1921, 628 A) was in use by 18 firms late in 1921 and contracts were made for installations in 9 other plants.—(*U.S. Geol. Surv.*, Apr. 10, 1922.)

CANADA

Industrial Notes

The establishment of American branch factories in Canada continues this year to a greater extent than ever. The Anaconda-American Brass, Ltd. has been incorporated in the Dominion with a capital of \$1,000,000, with head office at New Toronto, Ontario. The Lion-Meade Tyre Co., capitalised at \$2,500,000, is building a factory at Wrightville, Hull, Quebec. A large factory for the production of asbestos goods, at Asbestos, Que., is being erected by the Johns-Manville Co., of New York; over \$1,000,000 is being spent on the building and equipment, and the very extensive deposit of high-grade asbestos at Thetford Mines has been acquired. Among other American industries that have recently set foot on Canadian soil are cutlery

manufacture, at Hamilton and Welland, electric bulbs at Oshawa, automobile plants at Sarnia and Windsor, silk mills at Cowansville, silk-dyeing and finishing at Drummondville, and textile-dyeing at St. Johns. The number of new industries initiated at Hamilton, Ont., during this year is 13, as compared with 24 for the whole of last year.

It is announced that Bryant and May, Ltd. has acquired the majority of the stock and controlling interest in the Canadian plant of Maguire, Paterson and Palmer (Can.), Ltd. at Pembroke, Ont., and the establishment will be under the same general management as the Canadian Match Co.

Projected Nitrogen-Fixation Plant

The Electro-Chemical Company of Canada intends to erect a plant for the fixation of atmospheric nitrogen at Queenstown, Ont., within a few yards of the power-house of Chippeawa Canal, on the Niagara River. The process employed will be that covered by the patents of J. S. Island. The company proposes to start with a plant of 3000 kw. which, it is said, when running at capacity, will have a potential output of 3174 tons of nitric acid (commercial 64 per cent.) annually. Experimental plants have been in operation at Brantford and Niagara Falls, Ont. Calcium nitrate will be the chief product.

Mining and Metallurgy

British Columbia.—Large deposits of kaolin have been found in the Cariboo District, south of Williams Lake and about half a mile from the Pacific Great Eastern Railway.

The Granby Consolidated Mining, Smelting and Power Co. is producing copper at 9.7 cents per pound. This is the lowest cost in the history of the company and compares with 11.63 cts. in 1921 and 15.94 cts. in 1920. It is hoped to reduce the cost still further after the new hydro-electric installation has been completed.

The spelter trade of British Columbia is very active, and large shipments are being made to the Orient and Europe. All the stock of lead and spelter which had accumulated after the war, owing to price conditions and irregular exchanges, has been cleaned up. A year ago Japan commenced extensive purchasing of spelter, which was followed by European buying, with the result that the demand for lead and zinc in foreign markets is almost exceeding the supply.

It is announced that legislation will be submitted during the next session of the British Columbian Legislature with a view to the establishment of iron and steel works. A company has been organised with a capital of \$12,000,000, and, according to the announcement, the provincial government will unite with the Imperial and Canadian governments and guarantee, as its share, bonds not exceeding \$1,000,000. The Coast Range Steel Co. has been incorporated with a capital of \$15,000,000, and it is understood that representatives of the company have discussed the matter with the facilities committee of the Imperial Board of Trade and the British Columbian government. The proposed plant will have a production of about 120,000 tons finished steel per annum.

Northern Ontario.—Rich silver ore has been found on the property of the Wigwam Silver Mines, at Wigwam Lake, in the Gowganda district. The company is controlled by Montreal interests.

The magnitude of the development of the gold mines of Northern Ontario is attracting world-wide interest, resulting in efforts being made by well-known mining capitalists to obtain control of developed properties. It is reported that the Teck-Hughes mine will pass into the control of the Consolidated Goldfields of South Africa. Interests associated with the International Nickel Co. are also reported to be endeavouring to secure some properties. The Kirkland Lake Mining Co. has struck rich gold ore on its property. The mine adjoins the Teck-Hughes, and the main shaft is down 1000 feet. Important strikes are reported from the Holtrex district, north-east of McIntyre and Hollinger. The value of the ore was \$9.60 per ton.

Alberta.—A large consignment of McMurray tarsand has been shipped to Swansea, Wales, for extraction of bitumen at an experimental plant. Several small-scale plants have been built and operated in Alberta for the treatment of these bituminous sands, but, so far, no authentic figures have been given of yields and approximate costs.

FRANCE

Industrial Notes

Chemical Industry.—The destruction by fire of Merck's factory at Darmstadt will affect the supply of fine chemicals in France. After the conclusion of hostilities the reappearance in the French market of Merck's products was received almost with a sigh of relief, so bad had the substitutes been found to be. This does not necessarily mean that French fine-chemical manufacturers cannot make products as good as those of Merck, but rather that they are too heavily handicapped by excessive manufacturing costs, for which the high prices of raw materials are responsible. To take one instance: the price of alcohol, a basic raw material, is always maintained at an exorbitant level.

The rumour that, in accordance with the Wiesbaden "agreement," a group of French dye-works is negotiating with German chemical firms for the supply of chemicals, is viewed with great concern by French chemical manufacturers, as such a policy would eventually lead to the closing down of their works.

The demand for ammonium sulphate and calcium cyanamide is very keen, but there are practically no inquiries for nitrate.

Metallurgy.—The demand for metallurgical products has slackened, although stocks, particularly of pig iron and semi-finished products, have been almost exhausted by orders from Great Britain and America. Prices, however, seem fairly stable. There is great activity among makers of iron and steel goods, especially agricultural machinery, but owing to foreign competition the production of machine tools is suffering severely. The announcement that a metallurgical trust, under the control of Herr Stinnes, was being formed between firms in Lorraine and Germany, came as a great surprise. As the French metallurgical firms find difficulty in obtaining adequate supplies of coke and the German firms are confronted with short supplies of iron ore, it seems natural that efforts should be made to arrive at some kind of industrial "understanding"—not to use the word "trust," for so far the problem has been considered without any idea of an *entente*. At present the French are investigating means of producing a good metallurgical coke to

replace Ruhr coke, and the Germans have started to make plant for producing pig iron, now imported from France. Under the projected agreement, (1) the Germans would not need to build such plant; (2) the Ruhr would furnish the Lorraine works with a steady supply of coke, after "reparation" coke had been delivered; (3) the Hagondage, Knutange and Rombas works in Lorraine would supply the German metallurgical industry with semi-finished products; and (4) German capital would be represented to the extent of 25 per cent. of the capital of the Lorraine companies. The Lorraine firms mentioned deny that they have come to any agreement with the German firms, but the general impression is that strong influences on both sides are working to discover some common ground on which to base an understanding. The idea of German financial intervention is, of course, out of the question.

GERMANY

German Dyestuffs for the United States

After consultation with the Allied Powers, Germany has agreed to deliver to the United States dyestuffs to the value of \$256,000,000 on account of the cost of the American Army of Occupation in Germany.—(*Ind.- u. Handels-Z.*, Sept. 30, 1922.)

Discovery of Iron Ore

At the general meeting of the German Geological Society, held recently in Breslau, Herr Krusch, of Berlin, reported that a new iron ore worth exploiting, called "white iron ore" and consisting of nearly pure iron carbonate, had been found in bands of 2 metres in thickness in the low-lying moorlands of North Germany.

The Fire at Merck's Factory

The fire which broke out on September 15 in the establishment of E. Merck in Darmstadt was confined to the store-rooms and was soon brought under control. The factory itself did not suffer. No explanation is forthcoming as to the origin of the outbreak, but the loss incurred is covered by insurance.—(*Chem. Ind.*, Sept. 15, 1922.)

Agreement Among German Glassmakers

According to the *Berliner Tageblatt*, the Union of German Factories for Glass Instruments in Ilmenau, and the Union of Thermometer and Glass Instrument Factories in Roda, have formed a community of interests ("IG"), and it has been agreed that glass tubes made by the firms of Schott (Jena), Fischer (Ilmenau), and Greiner and Friedrich (Stutzbach) shall be sold only to members of the two Unions.—(*Bd. of Trade J.*, Sept. 23, 1922.)

Dutch Clinker

In many Dutch and German streets, particularly the former, a beautiful bluish clinker is used for street-paving. Little is known of the nature and origin of this material, but usually it is the so-called Dutch clinker which, by the use of suitable raw material and fuel, is obtained after long baking in the form of very durable bricks. According to P. Thor (*Tonindustrie-Zeitung*) these are still made mainly in simple clamp-kilns, though ring-kilns with a temporary reducing atmosphere have been successfully introduced in northern Holland. The best fuel is a cut peat of medium calorific value and the firing period lasts from 15 to 20 days, according to the size of the kiln.

The New Börner Airship

In the issue of *Kraft und Stoff* for August 19, S. Hartmann describes the Börner airship, in which an external envelope of nitrogen is used to protect the mixture of coal gas and hydrogen contained in the balloon. Duraluminium is used in the construction of the vessel which, filled with 300,000 cb.m. of gas, could carry a useful load of 90 to 100 metric tons on a continuous voyage of 5000 to 6000 km., and could travel to New York in 48 (?) hours.—(*Chem.-Z.*, Sept. 9, 1922.)

Rapid Evaluation of Motor Fuels

The Chemische Fabrik A.-G. has placed on the market a simple apparatus for rapidly estimating the value of a motor fuel. The method is based upon the work of the late Karl Dietrich, and utilises the comparative insolubility of purified "dragon's-blood" resin in benzine and paraffin hydrocarbons, and its solubility in benzol, alcohol, and halogen derivatives of the paraffins. The procedure consists of shaking a piece of "dragon's-blood" test-paper with a sample of the liquid fuel in a glass vessel; benzine remains colourless, but benzol and alcohol become dark red. The test is carried out more accurately by placing the end of a piece of filter paper in the liquid, which is coloured preferably with "dragon's-blood." The height of capillary ascent of the liquid and the characteristic zones of colour formed on the paper afford information concerning the composition of the fuel, and this may be confirmed by determining the refractive index of the fuel.

Mineral Production, 1913-20

The following statistics give a general view of the course of mineral production in Germany in the period 1913-1920. The ores for which output figures are given, in thousands of metric tons, are not only important as sources of metals but as raw materials of the chemical industry.

	1913	1917	1919	1920
<i>Copper and arsenical ores:—</i>				
Output of crude copper ore	947.8	960.1	616.8	576.2
Output of crude arsenic ore	25.8	39.1	26.1	38.4
Number of employees	13,292	15,122	12,196	10,849
<i>Lead, silver and zinc ores:—</i>				
Output	2,884.8	2,812.7	1,703.4	1,772.7*
Number of employees	21,282	18,223	17,047	18,018
<i>Pyrites:—</i>				
Output	268.6	803.7	381.4	426.3
Number of employees	821	1,920	1,604	1,821
<i>Tungsten ore:—</i>				
Output	15.8	106.8	20.6	1.4
Number of employees	148	613	370	69
<i>Bauxite:—</i>				
Output	—	10.8	9.4	13.4
Number of employees	—	190	173	310
<i>Tin, cobalt, nickel, bismuth and sulphate ores:—</i>				
Output	34.3	138.0	123.3	65.5
Number of employees	585	1,020	1,326	1,071

* In Upper Silesia the output of ore was 10,32,700 t.

† The output for 1913 is included in the production of tin, cobalt, etc. ores.

The very small output of tungsten ore in 1920 was due to the resumption of importation, imports being six times as great as in 1913; and the reduced output of ores of tin, cobalt, etc. was the result of foreign competition. Of all the ores mentioned, zinc-ore production shows the largest decrease compared with that of 1913, viz., 54 per cent. Formerly the production of zinc metal was only 11 per cent. behind that of the United States, much imported ore being smelted; but in 1920 there was an excess of 2247 t. of exported over imported ores, and the production of metal fell to 77 per cent. below that of the United States. The partition of Upper

Silesia has entailed the loss of 66.1 per cent. of the output of zinc ore and 60.2 per cent. of the production of metal.

BRITISH INDIA

First Forecast of the Sesamum Crop

This official forecast includes, for the first time, the crop under sesamum in Burma. The total area planted to this crop in British India, exclusive of the United Provinces, is estimated to be 2,329,000 acres, which compares with 1,543,000 acres (excluding Burma) at the same time last year. Except in Bengal, the weather at sowing time was favourable and the present condition of the crop is good, although rain is wanted in certain areas.—(*Ind. Tr. J.*, Sept., 7, 1922.)

SOUTH AFRICA

Motor Fuel from Maize

The Diamond Motor Spirit Co., Ltd., has been formed in England, and will be registered shortly in South Africa, for the purpose of manufacturing industrial alcohol from maize. A site for the factory has been selected in East London, and the erection of buildings and plant will be begun at the end of the year. The total cost is estimated at £100,000, and the production is estimated at 8000 to 10,000 gallons of spirit per day. It is hoped to retail the spirit profitably at 1s. 6d. per gallon.—(*S. Afr. J. Ind.*, Aug., 1922.)

Nicotine Content of S. African Tobacco

In view of the proposal to establish a tobacco-extract factory in the Piet Retief district, Transvaal, the nicotine content of tobaccos from different localities in South Africa has been investigated under the direction of Dr. C. F. Juritz. It was concluded from the investigation that the air-dried leaves of the heavier tobaccos, such as those grown at Barberton, Piet Retief, and Potchefstroom, contain from 3 to 5 per cent. of nicotine, and the leaves of the lighter tobaccos not much above 2 per cent. and often less than 1 per cent. Leaves of the common wild tobacco (*N. glauca*) appear to contain much less than 1 per cent., but those of *N. rustica* have yielded 6 to 8 per cent. and even more of nicotine. The alkaloid occurs in all part of *N. rustica*, but mainly in the leaves, and mature plants show the highest content.—(*S. Afr. J. Ind.*, Aug., 1922.)

JAPAN

Rejection of the Dye Embargo

The Japanese Government has declined either to grant an embargo on imports of dyes or to increase the duty to protect the home dyestuffs industry. Japanese dye manufacturers asked for the duty to be increased from 35 to 70 per cent. *ad valorem* and for the imposition of import licences to cover the following colours made satisfactorily in Japan:—Rhodamine B, Methyl Violet, Bismarck Brown, Fast Red A, Malachite Green, Direct Black, Naphthol Brown, Cotton Violet, Sulphur Black, Sulphur Brown, Magenta, Orange A, and Congo Red. At present Japanese dyestuffs find a market only in adjacent countries and then only at very low prices. The home market is overstocked with German dyes, against which American, French, and Italian products are competing, and sales are limited by the depression in the textile industry.

About one-half of the Japanese consumption of dyestuffs is imported, the total value of the requirements being roughly \$15,000,000 per annum. Recently the value of imports from Germany and Italy has amounted to about \$7,000,000 per annum, and from the United States to about \$500,000.—(*Chem. and Met. Eng.*, Aug. 9, 1922.)

GENERAL

Oil Technology at Birmingham University

It is officially announced that the chair of mining in Birmingham University has been subdivided into two professorial chairs. One professor will devote his time to coal and metal mining, and the other will be wholly engaged in the department of petroleum and oil engineering, for which large sums have recently been received from leaders in the industry. It is intended to build up an important school of oil engineering which, with the exception of the Imperial College of Science, London, will be the only one of its kind in the British Empire. Prof. R. R. Thompson, formerly Director of Lands and Mines in Trinidad, has been appointed to the chair of oil mining, and Mr. K. N. Moss to that of coal and metal mining.

Home-Grown Sugar

Working arrangements have been made for the future amalgamation of Home Grown Sugar, Ltd. and of the English Beet Sugar Corporation, Ltd., which owns the Kelham and Cantley beet-sugar factories, respectively. In accordance with these arrangements, the British Sugar Beet Growers' Society, Ltd. announces that, this year, the sugar-beet crops grown for Kelham will be worked at the Cantley factory. By working the crop, now grown on more than 8000 acres, in one factory, which will thus be able to work at full capacity, it is hoped to ascertain the lowest economic cost of production for future guidance. Proposals for improving and extending the Kelham factory for the same purpose are under consideration.

Dry Cooling of Coke

A correspondent to the *Times Trade Supplement* of September 9 outlines a new method of quenching coke which has been operated at the gasworks at Zürich. The glowing coke is placed in a closed tank through which a stream of non-inflammable gas is circulated by means of an electric fan; the gas may be flue gases or air from which the oxygen has been removed by previous contact with hot coke. The heat taken up by the gas is utilised in raising steam, and the gas is re-circulated through the tank until the temperature of the coke falls to about 500° F., at which the coke does not break into flame on exposure to air. The first year's working at Zürich showed that one ton of coke yielded an average of 886 lb. of steam at 57 lb. pressure, with feed water at 40° F., so that 1 lb. of coke yielded 450 B.Th.U. in the form of steam. Large quantities of heat and therefore of fuel may thus be saved; the coke produced is of better quality; and less labour is required because the plant is automatic. As the coke is discharged intermittently, a supply of steam has to be provided while the tanks are being refilled.

Peppermint Oil in China and Japan

China and Japan are the only countries in the Far East which produce peppermint oil in important quantities. In China the chief centre of

production is Kwantung province, the oil is extracted at Canton, and about 2500 lb. per annum is exported, mainly to Hongkong. The plant is also grown in Kiangsi province, but very little oil is exported. In Japan, the largest centre of peppermint cultivation is Hokkaido, where over 20,000 acres are planted. The districts of Bizen, Bingo, Bitchie, Shitsuka and Okujoto are also large producers. The export from Japan in 1920 was 185.3 tons of peppermint oil, valued at 1,812,366 yen, and 221.5 t. of menthol, valued at 5,489,815 yen (yen=2s. 0½d. at par). The United States is the chief consumer of Japanese menthol and peppermint. Japanese peppermint oil has an unusually large content of menthol; the dementholised oil has a disagreeable taste and odour and compares unfavourably with the product of other countries (*cf. J.*, 1919, 404 r; 1921, 106 r).—(*Ch. of Comm. J.*, June 9, 1922.)

New Manganese Deposit in Hungary

The deposit of manganese ore recently discovered near Urkut lies on the southern spurs of the Bakony Forest, north of Balaton Lake. It will be developed partly by open and partly by underground workings. The initial plant is already being erected, so that the works will probably be in operation by the middle of 1923.

PERSONALIA

Dr. P. Uhlenhuth has been appointed director of the Institute for Experimental Therapy Emil von Behring in Marburg a/Lahn.

Dr. G. P. Teodorescu, of the University of Berlin, has been appointed professor of analytical chemistry in the Polytechnic, Bukarest.

Prof. A. Lottermoser has taken up his duties as director of the laboratory for colloid chemistry, recently established in the Technical *Hochschule*, Dresden.

The Hanbury Gold Medal of the Pharmaceutical Society has been awarded to Prof. E. Perrot, of the Faculty of Pharmacy in the University of Paris, for his researches in the natural history of drugs.

The Council of the Chemical Society has elected Prof. J. F. Thorpe to succeed Dr. M. O. Forster as hon. treasurer, and Dr. J. T. Hewitt to fill the vacancy so created in the list of vice-presidents.

Dr. F. B. Power, director of the biochemical department of the Bureau of Chemistry of the United States Department of Agriculture, has been awarded the Flückiger Medal of the Swiss Pharmaceutical Society.

Prof. F. T. Trouton, F.R.S., emeritus professor of physics in the University of London, died on September 21, aged 58 years.

Major-General J. Waterhouse, formerly Assistant Surveyor-General of India, died on September 28, aged 81. The deceased received the Progress Medal of the Royal Photographic Society in 1890 for his spectrographic investigations on the action of dyes on dry plates, and served as president of that Society from 1905 to 1907. In 1895 he was awarded the Voigtländer Medal of the Vienna Photographic Society.

REPORTS

REPORT OF THE GOVERNMENT CHEMIST UPON THE WORK OF THE GOVERNMENT LABORATORY FOR THE YEAR ENDING MARCH 31, 1922. Pp. 33. London: H.M. Stationery Office, 1922. Price 1s. 6d.

The total number of samples examined at the Central Laboratories in London and at the chemical stations in the provinces was 302,562, or 6113 less than during the previous year. Additional work has been imposed on the Department in connexion with the Safeguarding of Industries Act, the Dangerous Drugs Act, and the Dyestuffs (Import Regulation) Act. The report contains detailed statistics relative to the work done for various Government Departments, together with summarised results of some of the analyses made and observations upon matters of outstanding interest.

During the examination of dairy produce it was noted that the proportion of fat in different samples of cheese varied between 9.9 and 38.8 per cent., but no exception could be taken to this, as there are no regulations relating to the marking of unskimmed cheese. There were also large variations in the fat content of condensed milks owing to the adoption of different degrees of evaporation during manufacture.

Work connected with the analysis of waters is increasing because of the investigations being conducted upon the effect of drainage from tarred roads and of other types of pollution upon fish and fish food. Sea-waters are being examined in connexion with the oceanic research scheme of the Fisheries Departments, and efforts are being made to devise a more rapid method of determining the salinity that can be applied readily at sea.

The analyses of several fertilisers and feeding-stuffs were found to differ from the guarantees given upon invoices. One compound manure, sold without a guarantee, was found to contain only 2.6 per cent. of nitrogen and only such a proportion of phosphates and potash as would be found in ordinary soil. Cement, plaster, burnt wood, paper, string, glass and gypsum were found in materials purporting to be feeding-stuffs.

In connexion with the assessment of beer duty 29,642 samples were tested. There were only 702 samples of imported beer, as compared with nearly 10,000 in the year before the war. Arsenic in excess of the legal limits was found in 24 samples of brewing materials, 2 samples of malt and sugar, and 3 samples of beer and wort.

The question of the presence in chocolate of fat other than cocoa butter has continued to receive attention, and the method of determination previously described has given satisfactory results (*cf. J.*, 1921, 372 r).

Fourteen samples of drugs were found to contravene the provisions of the Dangerous Drugs Act. Over 3000 samples were examined under the Safeguarding of Industries Act; in many cases the analysis was complicated, the nature of the examination required being frequently entirely different from that employed commercially.

The characteristics of denaturants and colouring substances for alcohol intended for industrial use have been specially investigated during the year. For the purpose of controlling the use of duty-free spirits many samples of denaturants, spirits, resi-

dues from stills, and manufactured articles were examined. Samples of imported and home-produced fusel oil were examined to ascertain whether they contained less than 15 per cent. of proof spirit or whether they were dutiable.

The variety of preparations containing sugar is so great that fixed rates of duty have been adopted for those regularly imported or exported, but there are many articles which have to be examined on each importation. Owing to the heavy duty on saccharin, search has to be made for it in all preparations in which there is any probability of its occurrence.

All consignments of tea imported are examined for purity; owing to the high prices ruling and to the dislocation of foreign markets numerous small shipments of doubtful quality have been made and have necessitated very extensive sampling. The packages condemned numbered 5035.

Many samples of tobacco were examined to determine the rate of duty and the contents of water and olive oil. Denaturants for tobacco, such as sulphur, asafoetida, sago flour, tar oil, carbolic and cresylic acids, moss litter, soda ash, borax, hellebore, cayenne, lampblack, and saltpetre, essential oils for flavouring purposes, and preservatives, were also examined.

The recovery of radium from one batch of luminous dials, gunsights, etc. was completed for the Disposal Board, over 300 mg. of radium bromide of 90 per cent. purity being obtained. In addition, 100 mg. of concentrated material suitable for immediate use was recovered.

The quantity of lead contained in the fumes evolved during the cutting of ships' plates by oxy-acetylene burners has been investigated (*cf.* Report on Factories and Workshops, J., 1922, 334r). Specimens of dust from a plant used in bleaching flour were found to contain basic tin nitrate, the violent decomposition of which had been responsible for an explosion.

REPORT OF THE COMMITTEE OF THE PRIVY COUNCIL
FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.
1921—22. Pp. 123. H.M. Stationery Office,
1922. [Cmd. 1735.] Price 3s.

The economies effected recently in the Department of Scientific and Industrial Research have not interrupted good work already in hand, but have merely slowed down the programme of research. The total expenditure of the Department in 1921—22 was £525,584, and the net expenditure from public funds, exclusive of grants to research associations, was £333,552 (against £427,432 in 1920—21). Among the separate items were £190,024 (less receipts) for the National Physical Laboratory; £43,266 for the Fuel Research Station (less £1,883 from sales of by-products); £57,423 on the Geological Survey and Museum; £10,323 for the work of the Building Research Board; and £17,750 on the station for low-temperature research at Cambridge. Expenditure on grants in aid of scientific investigations conducted by other bodies amounted to £8287, and £47,005 was given in allowances to University research students (205), independent research workers (55), and to scientific workers (20) for the employ of laboratory assistants or the purchase of equipment.

Twenty-two of the 24 associations that have received licences are in active work and 3 new

associations are likely to be formed shortly. Research associations, it is stated, cannot look for further grants from Parliament after the original fund of £1,000,000 has been exhausted. Reports are quoted from firms in the Portland cement industry as to the value of the work done by its association, and among other useful work accomplished is recorded the preparation by the British Scientific Instrument Association of a new polishing powder and a new abrasive for optical elements, the use of which saves much time and material. The association for the cotton industry has produced an instrument for recording the regularity of yarns, and that for the linen industry means of readily distinguishing flax and hemp fibres. In several instances research associations are engaging in co-operative work, and individual associations are undertaking fundamental scientific investigations.

Through the co-ordinating research boards Government departments are conducting their research work in closer co-operation, and there is a growing tendency to publish results. Under the Chemistry Co-ordinating Research Board researches on the partial oxidation of hydrocarbons have been carried out at the Royal Naval Cordite Factory, where a semi-technical plant is being erected to obtain data on the possibility of manufacturing formaldehyde by this method; and under Dr. D. L. Chapman, of Oxford, results of much scientific interest have been obtained on the indirect production of methyl alcohol from methano *via* methyl chloride. The British Scientific Instrument Association has elaborated a method of producing zinc sulphide with a luminosity, in presence of radium, much greater than that obtained hitherto. Applications to the Board to conduct in Germany an inquiry into the causes of the explosion at Oppau were refused, but certain theories relating thereto are being investigated in the Government Laboratory and at Woolwich. Other work undertaken, or considered, bore on the improvement of accumulators and dry cells, the manufacture in this country of celluloid film for photography, and the corrosion of aluminium and its alloys. In the Oxygen Laboratory of the Air Ministry the question has been considered of replacing charcoal by non-inflammable substitutes as an adsorbent in the vacuum space of liquid-air containers, with the result that silica appears to be a good material for this purpose.

Physical properties of gases that are commonly stored and transported as liquids are being determined at the National Physical Laboratory for the Gas Cylinders Research Committee, which is also considering the use of alloy steels for making gas cylinders. Although fewer tests have been made at the National Physical Laboratory, more special researches have been conducted for research associations and private firms. The metrology department has been busy; the engineering department is making investigations for the Lubrication Research and other committees; the metallurgical department has published the results of researches on aluminium light alloys, and, in conjunction with the Iron and Steel Institute, has prepared chemically standardised samples of steel.

The Fuel Research Board has studied the steaming of coal in vertical gas retorts, the national coal resources, pulverised coal, peat, and domestic heating, power alcohol is still being considered, and

experiments are to be undertaken on the production of tetrahydronaphthalene ("Tetralin") for admixture with petrol as a motor fuel. Research has been initiated by the Building Research Board on cement, brick-burning, titanium dioxide as a substitute for white lead, and the use of "Dekalin," a naphthalene derivative, as a thinner for paint. The new low-temperature research station of the Food Investigation Board has been completed, and work is being continued on the production of lactic acid in muscle at low temperatures, on putrefaction, etc. Information on the present practice in kiln-drying timber has been collected by the Forest Products Research Board, of which Prof. J. B. Farmer has been appointed chairman and Sir David Prain director of research. Work for the Lubrication Research Committee is proceeding at Cambridge (theory of friction), and at the National Physical Laboratory (pressure distribution in plain cylindrical bearings—failure in lubrication in large high-speed journals). The research work at the British Museum continues to yield valuable results, and the provision of a more convenient laboratory will enable the work to be extended.

The Board is considering the possibility of issuing accounts of investigations performed under its auspices to the daily Press.

REPORT ON THE INDUSTRIAL AND ECONOMIC SITUATION IN GREECE, TO APRIL, 1922. By E. C. D. RAWLINS, H.M. Commercial Secretary, Athens. Department of Overseas Trade. Pp. 73. H.M. Stationery Office, 1922. Price 2s.

During 1921 Greek trade and industry suffered severely from political and economic difficulties, and the cereal crops were poor. Production of olive oil declined to 45,180 metric tons, but efforts are being made to improve the industry by introducing modern appliances for extraction and by combating the olive fly which greatly reduces the crop. The vullonea crop of 500 tons was nearly double that of 1920. Exports of emery rose by 2317 to 12,709 tons. The Anglo-Greek Magnesite Co., Ltd. (a British company), produced 33,100 t. of crude magnesite, but exported, mainly to Holland and Germany, only 9130 t. of crude, 7055 t. of caustic calcined, and 750 t. of dead-burnt magnesite; other companies shipped 10,000 t. of crude ore, chiefly to Holland. The demand for magnesite was poor. Most of the chromo ore mined was shipped to France. The smelting of lead and zinc ores at Laurium and the mining of manganese ore are still restricted; the average value of the annual output of lead and arsenious oxide is Dr. 4,000,000 (average value of drachma in 1921 = 3·15d.).

Greek industry is small compared with that of Western Europe, but Greek products, such as soap, fertilisers and cement, are exported to other countries of the Levant. Development of the rich beds of lignite and of the potentially available water-power (estimated at 365,000 h.p. in Central Macedonia and the Greek mainland) would do much to promote industrial life. The chemical and related industries are progressing. There are four up-to-date factories for the manufacture of glass and pottery, sulphuric acid (from local pyrites) and fertilisers are made in one large works, and there is one modern factory making coal-tar dyes. Soap, sulphur oil, turpentine oil and colophony are manufactured from local raw materials; the leather

industry has been long established; and there are six paper factories and five breweries.

The value of imports during 1921 was Dr. 1,674,375,055 compared with Dr. 2,131,038,321 in 1920. British trade lost ground to countries with depreciated currencies. Pharmaceutical products are now mainly supplied by Germans, who are also doing much trade in heavy chemicals; soda products, formerly almost a British monopoly, are being imported from Antwerp at a much lower price than the British; and glassware is once again being derived from Czechoslovakia. Exports in 1921 increased in value by Dr. 167,057,623 to 831,170,270. Detailed statistics for the complete year are not available.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for September 28 and October 5)

THE GAS-MANTLE INDUSTRY

The text of the report of the committee appointed under the Safeguarding of Industries Act, Part II., to inquire into the importation of German incandescence gas mantles into this country, is given in the *Board of Trade Journal* for October 5. The committee's conclusions are summarised as follows:—

We are in the main satisfied that the bulk of the German mantles which are imported into this country are sold to dealers at the prices fixed by the Convention of German Mantle Manufacturers.

This price is very much above German manufacturing costs, very considerably lower than the costs of manufacture of the principal British manufacturers, and distinctly lower even than the lowest prices of British mantles quoted by the opponents as an indication of the real minimum cost of manufacture in this country. We find that the difference between the costs put before us by the principal British manufacturers and the price of the German goods is so large as not to be substantially affected by any qualification we may make with regard to the former.

We are of opinion that this capacity to undersell is principally due to the advantage which the Germans derive from their low costs in respect of labour, salaries, and other overhead charges, when reckoned in sterling, for the reason that these charges have not increased in proportion to the decrease in the exchange value of the currency. This advantage is not offset to any appreciable extent by any necessity to purchase raw materials abroad.

We are of opinion that, in view of the progressive rise in German imports, coincident with a decline from other sources, and in view particularly of the wide margin between German domestic wholesale prices and the Convention selling price in Great Britain, these imports have, and are likely to have, a serious effect upon employment in the home gas-mantle trade.

We are not convinced that the imposition of a duty on gas mantles would have any appreciable effect on employment in the gas industry, which is the only industry which, we think, could possibly be considered as using mantles as *material*.

We are of opinion that the gas-mantle industry is over-capitalised, and that this fact must tell against full economy in cost control, but that, as regards processes of manufacture and use of materials, it is up to date and efficiently conducted.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Australia ..	Industrial chemicals, spring steel	356
Brazil ..	Iron and steel	352
British West Indies ..	Cement	9529 E.D./M.C.
Canada ..	China-ware	323
" ..	Pig iron	9594 E.D./E.C.
Czechoslovakia ..	Pharmaceutical goods, drugs, patent medicines ..	333
Egypt ..	Glass, glassware, pottery ..	225 36 F.G./M.C.
" ..	China, earthenware, soap, perfumery, leather ..	371
France ..	Boot and metal polishes ..	711 F.G. M.C.
" ..	Yeast	363
Germany ..	Ores, metallic residues ..	334
Hungary ..	Leather	335
Italy ..	Tin, tinplate, blackplate, copper ..	336
" ..	Iron, steel, tinplate, copper and brass pipes, lubricating oils ..	365
Mexico ..	Coal-tar dyes	6829 F.L. C.C.
" ..	Kola oil, extract of coca, caffeine and hyssop	6747 F.L. C.C.
Netherlands ..	Chemicals, soap, perfumery ..	337
" ..	Alum, formaldehyde, caustic soda, Epsom salts, sodium sulphate, ferrous sulphate, soda crystals, sodium bicarbonate, tartaric acid, sodium bisulphate, sodium sulphite, copper sulphate, ammonium chloride, glacial acetic acid (98-100%), etc., paper, earthenware	341
Norway ..	Leather, imitation leather ..	368
Switzerland ..	Boot and metal polishes ..	711 F.G. M.C.

TARIFF CUSTOMS EXCISE

Angola.—The duty on rubber exported from ports outside the Congo Basin has been reduced to 0.1 per cent. and 0.2 per cent. *ad valorem*, respectively, according as the destination is to a Portuguese or a foreign port.

Australia.—The duties on certain categories of iron and steel products have been amended. The complete text of the reciprocity agreement between Australia and New Zealand is published in the issue for October 5; British preferential rates of duty are accorded to all goods not specified in the schedule.

Belgian Congo.—An export duty of 10 per cent. *ad valorem* has been levied on hides and skins.

Canada.—Provisions for the valuation for customs purposes of goods imported from countries with depreciated currencies have been applied to goods made or produced in Austria, Czechoslovakia, Germany, Hungary, Yugoslavia, and Russia. The period during which oleomargarine may be manufactured in, or imported into, Canada has been extended until August 31, 1923.

East African Protectorate.—By the customs agreement entered into with Uganda all export duties have been abolished.

Egypt.—The import duties on alcoholic liquors have been revised.

France.—A "co-efficient of increase" of 3 has been applied to the import duties on cellulose pulp not destined for the manufacture of paper for newspapers, periodicals and other publications.

Germany.—Articles with a sugar basis and fruits preserved or prepared in spirits may not be imported. New rates of monopoly tax have been applied to imported spirits, and the tax on imported acetic acid and vinegar has been increased to 56,190 marks per hectolitre of anhydrous acid.

Greece.—Recent modifications of the import duties affect coconut and palm oils, groundnuts, petroleum, coal-tar dyes, Sulphur Black, ethers, certain wares of porcelain and glass. "Co-efficients of increase" have been applied to the duties on cocoa, metal polishes, petrol, alcohol, white metal, and the importation of "luxury articles" is prohibited.

Jamaica.—A list of new duties on exports of spirits, wines, or spirituous liquors has been issued.

Japan (Korea).—The duty on tinplate for use in canning cottonseed oil is reduced by 70 sen per 100 kin; for tinplate of United Kingdom origin this remission equals the amount of import duty leviable.

Mauritius.—Increased customs duties have been applied to denatured alcohol, methylated or plain spirits, etc.

Mexico.—New rates of export duty on petroleum and its products have come into force.

Morocco (French Zone).—The following consumption duties have come into force:—Saccharin and artificial sweetening substances, 500 fr. per kg.; glucose and unspecified sweet materials (excluding glucose used in brewing), 20 fr. per 100 kg.; sugared products, condensed milk containing sugar, from 20 to 60 fr. per 100 kg.

Netherlands.—Animal fats that bear proof of having passed an official inspection are exempted from the Dutch regulations for the inspection of imported meat.

Poland.—A surtax of 79,900 per cent. has been applied to the duties on imported spirits, cork stoppers, wares of porcelain and glass, scent and cosmetics, soap, washing blue, artists' colours, and manufactures of copper, tin and certain other metals and metallic alloys.

Portugal.—By a recent Decree, the surtax on colophony is fixed at 50 escudos per metric ton, on essence of turpentine at 500 esc. per m.t., and a special surtax of 10 per cent. is applied to goods not specially mentioned.

Portuguese East Africa.—*Ad valorem* rates of duty have been applied to exports of certain grades of sugar.

Rumania.—It is proposed to increase the duties on dextrin, starch, glue, sesamum oil, tartaric acid, and lampblack.

San Salvador.—Preparations for purifying water are dutiable at the rate of 2 centavos (gold) per kg. The import duty on perfumed and toilet soap has been reduced to 40 centavos (gold) per kg.

Solomon Islands.—The export duty on copra has been fixed at 12s. 6d. per ton, and on ivory nuts at 15s. per ton.

Yugoslavia.—The import duties on goose grease, lard, and raw pigs' fat have been withdrawn.

COMPANY NEWS

NOBEL INDUSTRIES, LTD.

NITRATE COMPANIES IN 1920-21

Of the eight nitrate companies whose financial year ended in June, 1921, all except one made increased profits, but only one paid a larger dividend and in three cases the dividend was reduced. Reserves increased by £35,145 to £639,333, and the sums carried forward rose from £116,868 to £335,088. The total share capital increased by £8268 to £2,045,068, due to the absorption of the San Lorenzo and Buena Ventura companies by the Liverpool Nitrate Co. Three companies disclosed an average estimated trading profit of 65·3d. per quintal (of 101·44 lb.), as against 30·5d. in 1919-20, and the combined trading profits of the eight companies represented 38·1 per cent. on the capital employed, compared with 30·5 in 1919-20. Dividends distributed amounted to £207,132, or an average of 10·1 per cent. on the total share capital, compared with £318,765, or 12·5 per cent., in the previous year.

The thirteen companies whose financial year closed on December 31 did badly during 1921: profits declined and dividends were reduced substantially. Their total issued capital was £3,664,950, the decrease of £200,000 being due to a reduction in the capital of the Lautaro Co. Debentures were diminished by £55,200 to £203,600. Reserves, excluding sums allocated to depreciation etc., fell by £249,351 to £959,665, and although most of the companies increased their carry-forward, a heavy reduction by the Alianza Co. brought the total down by £128,772 to £1,016,764. The position, however, is still good, as the reserves and carry-forward combined represent over 50 per cent. of the total share and debenture capital. The total estimated output was 2,965,417 quintals, which compares with 9,354,432 quintals in 1920. Reliable figures for calculating the average profit per quintal are not available. A total of £512,122 was distributed in dividends, representing an average of 13·9 per cent. on the total share capital, as against 21·7 per cent. paid on £3,864,950 in 1920.

Combining the figures of the 21 companies, the total share capital amounts to £5,710,018, upon which £719,254, or 12·5 per cent., was distributed in dividends, compared with £1,158,606, or 19·7 per cent., paid on £5,901,750 in 1920. Statistics of production, profits, etc. are appended.

The address of Sir Harry McGowan to the third annual general meeting, held in London on September 22, was devoted to a detailed explanation of the company's financial position and of its investments in associated companies. Nobel Industries, he said, had weathered the storm of industrial depression and the outlook was hopeful. One of the essentials at the present time was to reduce the cost of manufacture, and hence selling prices. Owing partly to a slight fall in the cost of raw materials, but mainly to the policy of concentration which had been pursued, the company had been able four times during the past twelve months to reduce the prices of explosives, etc. Although much trade had been lost owing to the coal stoppage and general depression, the gross profit for 1921 was over £1,200,000, and the net profit, after deduction of income-tax, was £809,211. Out of this sum it was proposed to allocate £350,000 to a reserve fund, to pay 5 per cent. on the ordinary shares, and to carry forward £463,349. [The issued capital is £15,818,654, of which £7,958,872 is in ordinary shares and £3,000,000 in 8 per cent. 7-year notes. Investments in associated and other companies stand at £21,013,040.] A consolidated balance-sheet had been made out for the year 1920, which showed that there was a surplus of £3,000,000 of assets over all liabilities, and that actual values existed in full, pound for pound, for the entire share capital, with a substantial margin. The position at December, 1921, would be found to be no less satisfactory, and at the present time neither the parent company nor any of its constituent companies were indebted to banks in any part of the world.

The company had a large interest (809,425 shares) in the General Motors Corporation, an American company whose business was now improving; the investment in the Dunlop Rubber Co., which had effected many economies, remained the same, as did also that in the British Cellulose Co., but, owing to financial reconstruction, Nobel Industries had been forced to accept 6 per cent. income bonds in lieu of first debentures. The directors of the Cellulose Co. were so satisfied with recent progress that they had decided to extend the plant. The chairman of the British Dyestuffs Corporation had assured him that its works were now much more

	Production Quintals	Inc. or dec. %	Trading profits £	Inc. or dec. %	Net profits £	Dividends %	Inc. or dec. %
Lagunas Synd. 1920-21	—	—	75,878	+ 99·4	27,287	Nil	—
Liverpool	—	—	317,755	+ 28·1	113,843	100	—40
London	—	—	100,893	+ 55·3	31,543	7½	—
Pan de Azuear	231,000	—38·2	48,361	+ 108·7	22,502	15	+ 5
Santa Catalina	143,243	—55·1	46,761	+ 61·8	30,879	20	—
Santiago	—	—	29,307	+ 42·8	15,197	7½	—
New Tamarugal	594,000	—40	167,160	+ 20·7	159,560	15	— 5
Rosario	476,691	—53·9	170,782	+ 19	99,441	10	—10
Aguas Blancas 1921	14,000*	—98·2	48,109	—29·5	35,373	70	—30
Alianza	341,000	—88·3	78,142	—91·1	2,929	40	—35
Angela	77,000	—50·8	27,232	—34·6	17,293	15	— 6
Anglo-Chilean	1,133,800	—35	294,086	—48·2	183,384	15	—10
Barrochenea	54,000*	—78·6	24,027	—34·3	12,409	35	—15
Lagunas Nitrate	116,000*	—75·7	40,470	—39·7	21,132	2	— 2
Lautaro	597,000*	—62	473,667†	—9681·3	Nil.	—	—
New Pachea	104,000*	—34·5	12,206	+ 57·3	9,546	6	— 2
Salar del Carmen	231,000	—11·1	86,807	+ 2·9	55,761	20	—
San Patricio	—	—	5,597	—46·4	2,568	2½	— 2½
Santa Rita	10,000*	—95·4	28,073	—31·5	17,020	15	—10
San Sebastian	66,617	—60·7	14,776	—67·8	5,881	Nil.	—
Tarapaca	152,000*	—76·4	57,343	—35·7	38,463	10	—

* Estimated. † Loss.

—(So. Amer. J., Mar. 18, Aug. 19, 1922.)

efficient than formerly, and that when the textile industry improved the company should be working on a profitable basis. All the shares of the British Pluviusin Co., which manufactured artificial leather, were owned by Nobel Industries, and good results were expected for 1922. Considerable economies in the manufacture of gas mantles had resulted from the formation of Lighting Trades, Ltd., but German competition was being felt severely. The Chilean Explosives Co., in which Nobel Industries held 50 per cent. of the capital and American interests the rest, was about to erect a factory for the manufacture of explosives, thus making Chile self-contained in that respect.

BRITISH GLUES AND CHEMICALS, LTD.

At the second annual general meeting, held in London on October 5, the address of the chairman, Mr. T. Walton, dealt mainly with the company's financial position. In 1921-22 there was a net trading loss of £64,177, against a profit in 1920-21 of £211,722, subject to taxation; the ordinary shares again receive no dividend (the preference dividend was paid up to October, 1921), and £64,177 is carried forward, against £149,873 brought in. The loss was due mainly to bad trade and to constantly falling values, which necessitated the writing down of stocks nearly to their pre-war values. Many improvements have been made in the factories and production costs have been sensibly reduced. There are no mortgages or charges on any of the company's assets and the balance-sheet shows a surplus of liquid assets over all liabilities, except taxation, of £298,140 (issued capital £1,399,984). The directors, who have waived their fees, are contesting the claims of the revenue authorities for a large sum in respect of excess profits duty.

AMERICAN CYANAMID COMPANY

The annual report of the board of directors states that in the financial year ended June 30, 1922, the company made a gross profit of \$621,765, after deducting \$699,081 for depreciation of plant, and that the net income was \$197,992, after setting aside \$288,975 for income-tax and depreciation of patents (issued capital \$12,190,200). The surplus account decreased by \$148,213 to \$3,143,276 and \$4,200,246 is held in reserve. Ordinary repairs and maintenance of plants during the year cost \$232,100, and extraordinary repairs and maintenance \$113,915. Results are considered gratifying in view of the prevailing abnormal conditions and the reduced activity in most of the company's departments. The company's interest in the Amalgamated Phosphate Co. is now valued at \$4,982,186, and in the Air Nitrates Corporation at \$1000 at par.

KAYE'S RUBBER LATEX PROCESS, LTD.

This company has recently issued a prospectus, for public information, which states that its object is to acquire and exploit Mr. F. Kaye's patents for the use of rubber latex in paper-making, and in new classes of goods such as substitutes for leather and linoleum, asbestos goods, etc. The authorised capital of the company is £12,000, of which £1000 is in £1 ordinary shares and £2000 in 1s. deferred shares. The purchase consideration is £2000 in cash and 18,000 deferred shares.

TRADE NOTES

BRITISH

The British Industries Fair, 1923

The Board of Trade announces that the British Industries Fair, 1923, will be held concurrently at the White City, Shepherd's Bush, London, and at Castle Bromwich Aerodrome, Birmingham, from Monday, February 19 to Friday, March 2. The trades to be represented in the London Section, the ninth of the series organised by the Department of Overseas Trade, include light and heavy chemicals, dyes, drugs and perfumery, glass and ceramic ware, scientific and optical instruments, paper, etc. In the Birmingham Section, organised by the local Municipality and Chamber of Commerce under the auspices of the Board of Trade, will be exhibited plant for brewing, distilling, mining, lighting and many other industrial purposes, metals and metal products (excluding precious metals), india-rubber goods, paint, colours and varnish, and weighing and measuring appliances. Approximately 90,000 illustrated booklets about the Fair are being distributed in all parts of the world as propaganda by the Department of Overseas Trade, which will also issue invitations to 50,000 overseas buyers. Prospects for securing overseas business are enhanced by the comparative failure of the Leipzig Autumn Fair, and as admittance is confined to *bona-fide* buyers, every visitor will be a potential customer. Further information can be obtained from the Department of Overseas Trade.

FOREIGN

German Trade in Chemicals in 1921-22

Although the depreciation of the German mark has led to increased exportation of many chemicals, the quantities exported are still far below those in 1913. The following figures of exportation make this clear:—

	1913	1920	July, 1921, to June, 1922
		Metric tons	
Potash salts	1,670,187	843,065	662,502
Ammonium sulphate	75,868	26,094	17,182
Sodium sulphate	83,230	15,487	46,734
Potassium sulphate	133,368		
Potassium magnesium sulphate	50,207	158,368	236,202
Potassium chloride			
Coal-tar and sulphur dyes ..	64,288	17,817	27,310
Allazartin and allazarin dyes ..	11,040	3,325	2,474
Indigo	33,333	6,671	12,710
Basic slag, ground	713,879	4,874	2,103
Superphosphate, etc.	282,653	1,040	13,494
Quinine and alkaloids	319	747	1038
Drugs, prepared	2,508	1,040	1,437
Chemicals, medicinal	1,291	285	578

Exports of potash began to improve in 1921, but fell off in 1922, although exports of other chemicals and pharmaceutical products increased. The next table shows the destinations of the exports of coal-tar and sulphur dyes in 1913 and during the first half of 1922.

	1913	Jan.-June 1922
Total export, Metric tons	61,288	15,541
United States, Per cent.	21.5	0.7
Great Britain	17.1	1.2
China	13.2	23.1
Austria-Hungary	9.0	—
Austria	—	4.0
Italy	6.4	3.5
British India	5.9	6.6
Japan	5.5	10.7
Belgium	3.9	0.6
France	2.2	—
Netherlands	2.1	3.5
Russia	1.3	—
Czechoslovakia	—	12.0
Baltic States	—	7.7

The chief market for German dyes is now China, followed by Czechoslovakia, Japan, the Baltic States, and British India. The United States has fallen in importance as a consumer from first to seventeenth place. The values of the chief groups of imports and exports during the years (ending March 31) 1914, 1921, and 1922 were as follows:—

	Imports			Exports		
	1913-	1921-	1922-	1913-	1921-	1922-
	Millions of dollars					
Plant products	98	261	173	201	483	318
Animal products	41	62	47	77	188	136
Fibres, textiles	109	244	140	22	19	5
Wood, wood products, paper	37	57	36	63	285	180
Iron and wares of	144	246	110	15	77	28
Non-ferrous metals and						
wares of	36	56	30	53	46	28
Minerals, non-metallic ..	85	208	138	9	40	23
Chemical and related products	17	36	24	5	20	9
Other products	52	73	24	6	32	14
Totals	619	1,240	748	432	1,189	740

Much ground has been lost in the export trade to Canada; Germany now holds only the fourteenth place, as compared with the fourth place in 1914.

Union of Bulgarian Producers of Otto of Roses

The producers of otto of roses in Bulgaria have amalgamated to form a combine bearing the above title. The Union has offices in Kazanlik and Sofia, with a branch office and store in Berlin, from which exportation is conducted by the Balkan Trading Company.—(*Chem. Ind.*, July 3, 1922.)

GOVERNMENT ORDERS AND NOTICES

IMPORT DUTY ON GERMAN GAS MANTLES.—The Board of Trade has issued the Safeguarding of Industries (No. 2) Order, 1922, dated October 7, imposing an import duty of 33½ per cent. *ad valorem* on mantles for incandescent lighting and component parts thereof, whether finished or not, manufactured in Germany. Certificates of origin are required for goods covered by the Order and consigned from European countries. The Order came into force forthwith (*cf.* p. 425 R).

DISTRIBUTION OF "REPARATION" DYE-STUFFS.—The Board of Trade has announced that the British Dyestuffs Corporation, Ltd. has been appointed its agent for the distribution of "Reparation" dyestuffs from Germany in place of the Central Importing Agency. In future, prices quoted will include delivery to purchasers' works or stores, and will not be subject to any commission. Prices will be quoted for packages of 60, 120, or 240 lb., and a reduction of 1d. per lb. will be made on purchases of 4 cwt. or more, and of 2d. per lb. on purchases of 1 ton or more; for less than 60 lb. the price will be increased by 1d. to 3d. per lb., to cover cost of extra packing. The Corporation may allow 30 days' credit on all accounts. The dyestuffs will be distributed under their original German denominations and, as far as possible, in their original packages. Notification of the arrival of additional quantities of dyestuffs (which will be reserved for actual consumers for 14 days) will be given through the Colour Users' Association, but the Corporation will issue a periodical list of stocks and of the current prices fixed by the Board of Trade. Inquiries should be addressed to the British Dyestuffs Corporation, Ltd., Reparation Department, 70, Spring Gardens, Manchester.

REVIEWS

MANUFACTURE OF NITRIC ACID FROM NITRE AND SULPHURIC ACID. TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918. No. 7. Ministry of Munitions and Department of Scientific and Industrial Research. H.M. Stationery Office, 1922. Pp. vi+86. Price 11s., post free.

The production of nitric acid from sodium nitrate and sulphuric acid was carried out on a very large scale during the war. Two national factories alone, Queen's Ferry and Gretna, were able to turn out 1300 tons of nitric acid per week. Although the method used was well known before the war, it had not been worked on such a large scale, and the appearance of the atmosphere around Queen's Ferry in the initial stages of its operation was sufficient to show that the problem of condensing the oxides of nitrogen produced in the works was not solved in the design of the plant. The final arrangements are described with admirable clearness by Mr. W. Macnab in the present report, which maintains the high standard of its predecessors and is a valuable contribution to the literature of chemical engineering.

The materials for the process, Chile nitre, and the pyrites for sulphuric acid, were imported, and the great demands made on shipping for this purpose at one time became extremely serious. Great Britain is still the only great power in the world which depends almost wholly on Chile for the supply of fixed nitrogen, and the description of the antiquated method of producing nitric acid from Chile nitre may therefore still possess an intrinsic interest. The question of this dependence, however, is one which must sooner or later be faced in the interest of national defence, and it is hardly conceivable that such immense retort plants for the production of nitric acid as were in operation during the late war will ever again be employed.

J. R. PARTINGTON.

DOCUMENTS AND THEIR SCIENTIFIC EXAMINATION. By C. AINSWORTH MITCHELL. Pp. xii + 215. London: Charles Griffin and Co., Ltd., 1922. Price 10s. 6d. net.

This is a welcome and valuable addition to the present scanty but growing literature of forensic chemistry and is written by an expert. The subject matter includes the examination of paper, pen markings, ink, pencils and their pigments in writing, handwriting, secret writing, typewriting, stamps, seals, envelopes and finger prints on documents. The apparatus and methods used are fully described and the book contains a large number of illustrations and an excellent bibliography.

The author explains that the book, which has especial reference to the chemistry involved in cases of suspected forgery, investigation of disputed documents and the comparison of handwriting, is based upon personal experience extending over many years, and that when called upon to present expert evidence in legal cases he frequently found that the available information was so inadequate or altogether lacking that he was compelled to make prolonged laboratory investigations in order to obtain trustworthy results. The present book contains the records of these experiments, some of

which have already been published in scientific journals, but many of which are now given for the first time.

The chapters on pencils and their pigments in writing (one chapter being devoted to blacklead pencils and another to copying-ink pencils) are particularly valuable, and contain a wealth of new information. Until Mr. Mitchell investigated the subject it was thought to be impossible to distinguish between writing made with different pencils, but it is now shown that under certain conditions the writing done with different pencils may be differentiated both by microscopical examination and by chemical tests.

The book summarises the proved results of the latest knowledge on the subjects treated, and is confidently recommended to all who are interested, whether from the point of view of the expert, who will find much that is new and to whom it will be especially useful; the lawyer, who will learn from it the possibilities and limitations of a subject with which he is frequently called upon to deal; the business man, especially the banker, who daily handles documents that may be forged; or even the general reader, who is interested in the practical application of chemistry to everyday life and who finds a fascination in mysteries and their solution.

The problem of whether a suspected document, which may be a banknote, a will, a promissory note, a deed of sale, a register, a passport, or even a postage stamp, is genuine or not is a constantly recurring one, and the book under review shows in a very practical manner how the truth should be sought and how it may be discovered. There is only one way, and that is by the use of scientific methods scientifically applied. The value of the expert is nowhere more patent than in questions having reference to suspected documents, since many of the facts can be found only by an expert, and he alone can present them in a convincing manner to a judge and jury.

The book is well arranged, well and clearly printed on good paper, and is strongly recommended.

A. LUCAS.

DIE LÖSUNGSMITTEL DER FETTE, ÖLE, WACHSE UND HARZE. By DR. H. WOLFF. *Monographs on the Chemistry of Fats*, edited by Prof. K. H. Bauer. Pp. vi+118. Stuttgart: Wissenschaftliche Verlagsgesellschaft, 1922. Price 9s.

During the past year or more a noteworthy feature of the oil and fat industry of Germany has been an active propaganda among its chemists in the direction of organisation and co-operation, ostensibly for the purpose of the furtherance of research. A perusal of the German technical journals leaves one with the impression that the spirit of pre-war days is far from dead, and that apparently, in spite of the present economic condition of their country, the chemists still hope and yearn for ascendancy in provinces not altogether restricted to the laboratory. As one result of this activity may be mentioned the projected publication of a series of monographs under the editorship of Dr. K. H. Bauer, dealing in a specialised manner more particularly from the technical standpoint with the various branches of the oil, fat and allied industries.

The first volume of these monographs, now before us, covering as it does a description of the properties and uses of most of the solvents employed in connexion with oils, fats, waxes and resins, undeniably fills a gap in this particular branch of technical literature. The information found in this work is for the most part either absent or only lightly touched upon in text-books on the chemical technology of oils, fats, waxes, resins, and the like.

This book, or, as it would be better designated, brochure, is divided into five main sections; the first deals in a somewhat general style with the determination of the physical constants common to most organic liquids. Density, refractive index, flash-point, boiling-point, methods of distillation for solvents of a wide boiling-range, and so forth, are each described, wisely without excessive detail. The methods given for fractional distillation, particularly those for paraffin oils, though perhaps not of great interest to the English reader—conforming as they do with German practice where the standardised apparatus used complies with the regulations issued by the German Government and other administrative institutions—are certainly instructive for comparison.

The second and main portion of the work discusses with reasonable detail individual solvents, their sources, methods of refinement and purification, and their relative merits and degrees of utility as media for effecting solution and extraction; the latter points being treated both from the laboratory and the industrial viewpoint. Amongst the hydrocarbons are described the newer synthetic products, the hydrogenated derivatives of naphthalene, "tetralin" and "dekalin"; substances not so well known in this country, but which have become notorious in Germany as a source of "copy" to the technical Press for controversial articles on their merits and demerits as articles of commerce. Following the hydrocarbons, including, of course, a full treatment of paraffin and coal-tar products as well as turpentine, are given the chlorinated compounds with their main redeeming feature, the minimised risk of fire. Alcohols, esters of formic and acetic acid, ether, and finally carbon disulphide, are all included. Where applicable, methods of quantitative estimation, chemical tests for impurities, and physical data are to be found in these individual descriptions. References, however, to English and American publications are sadly meagre, and to cite only one instance, the extensive work of Dr. H. G. Colman on the estimation of benzene and toluene in coal-tar distillates would, one might think, deserve mention in a work of this kind. A good deal of the data included in this chapter has been tabulated and incorporated in a copious appendix with other information of the nature usually found in chemical year-books.

An interesting discussion on the physiological properties of the solvents forms the third part of the book, whilst the fourth goes into the question of identification of the solvents either singly or in mixtures. In the final chapter is given a description of the methods of quantitatively determining the saponification and acetyl values of those solvents amenable to these tests.

On the whole, the book can be recommended as one of great utility; the style is lucid, the printing good. The author expresses a hope that the book will be of great practical use in the laboratory, but

it is certain that this poorly bound brochure edition would not stand for long the rigorous handling usually meted out to such books of reference. One other point which serves to emphasise the justification of the remarks made in a recent article in this *Journal* (1922, p. 111 n), is the fact that this book is published in Germany at 75 marks and its price on reaching this country is 9s., equal to about 2700 marks. Whilst no doubt one could hardly expect to benefit to the extent of the uttermost limit of the difference in the exchange, the great disparity between the two prices gives much food for thought.

E. R. BOLTON.

- (1) *LES COLLOÏDES*. By J. DUCLAUX. *Second edition, revised and enlarged*. Pp. x+305. Paris: Gauthiers-Villars et Cie., 1922. Price 10 francs. (2) *KOLLOIDE LÖSUNGEN*. By JOACHIM LEIMDÖRFER. Pp. 108. Augsburg: H. Ziolkowsky G.m.b.H., 1921. Price 4s. 10d. post free.

(1) The general trend of Duclaux's work is sufficiently indicated by two—slightly contradictory—passages in the preface to the first edition, of which the following is a careful translation: "One is entitled to assert to-day (*although the contrary opinion is widely held*) that the theory of the colloids is complete, and that it is possible to bring into it the same clearness as everywhere else. . . . The present theory of colloids, which will be found set forth below, and *which is now almost universally accepted*, is not the work of one day. . . ." (Reviewer's italics.)

The theory thus referred to is the author's well-known "Complex" theory of sols, or more particularly of the ferric hydroxide sol. This is held to consist of "micellæ" having the constitution: $n\text{Fe}(\text{OH})_3 \cdot \text{FeCl}_3$, which dissociate into the complex ion or "granule" $n\text{Fe}(\text{OH})_3 \cdot \text{Fe}^{+++}$ and the corresponding number of chlorine ions. The osmotic pressure of the sol varies with the number of ions formed, and therefore, assuming the concentration of $\text{Fe}(\text{OH})_3$ to remain constant, with the number n in the formula. Appropriate treatment, *e.g.*, prolonged dialysis, may cause this number to vary from 5 to 800. Electrolyte coagulation is an ordinary precipitation reaction, governed by stoichiometric relations and the solubility product. Although, admittedly, the sol of ferric hydroxide is the only one completely investigated in this sense, the theory is put forward as perfectly general, and all difficulties are to yield to its rigid application. The biologists in particular, whose ordinary methods the author criticises with some severity, are exhorted to lay it to heart.

It is rather surprising that the author makes no mention even of investigations tending in the same direction, such as the work of McBain and his school on soaps, or of Pauli's extension of the chemical theory to such systems as gold sols. No evidence on the other side is presented, nor is the re-examination of the ferric hydroxide sol by improved methods (Pauli and Matula, 1917) mentioned; indeed, the small number of names quoted throughout the book is remarkable, and practically no references are given.

In view of the dogmatic manner in which the "chemical" theory of coagulation is put forward,

the reader will be naturally curious to learn how the crucial phenomenon of protection is explained. He will be disappointed to find that the old suggestion of a coating formed by the protective colloid is all the author has to offer, although it has been repeatedly pointed out that the quantitative relations make this quite untenable, and although it is impossible to see how such a coating, even if it existed, could prevent the exchange of, say, SO_4 -ions with Cl -ions, which is said to bring about precipitation.

The descriptive parts of the book, as far as they do not suffer from the author's strong bias in favour of purely chemical theories, are written with great lucidity, and emphasis is rightly laid on the development of a specialised and perfected technique. Perhaps the least satisfactory chapter is that on adsorption, in which no reference is made to any of the theories of the phenomenon, nor to the large bulk of recent work which is gradually clearing up the anomalies found in experimental investigations, by examining the adsorption of the *solvent* as well as that of the solute.

Whilst the book cannot be said to give an adequate or comprehensive view of the present state of the subject, it should be of great interest to readers familiar with other text-books and prepared to exercise the chief privilege of thinking beings, that of making a choice.

(2) The merest tyro in epistemology would, on reading Leimdörfer's book, come to the conclusion that it could have been written only in German, with its extraordinary facilities for forming compound words, with which—presumably—an equal number of subtly differentiated concepts may be co-ordinated. This remark applies principally to the first part of the book, of which a little more will be said below; the second consists of a brief account of the properties of colloidal solutions and the methods used in their study, which does not differ materially, or favourably, from those to be found in the standard text-books.

The first part sets forth a theory of the constitution of matter which the reviewer cannot claim to have grasped. This failure will be viewed leniently, or even sympathetically, by anyone attempting to study the book and confronted with entirely unfamiliar concepts, such as a unit of matter called a "Schwebeteilchen" (the bald translation "suspended" or "floating" particle at once emphasises the unfitness of English as a medium for speculation); with chess boards of 49, 121 and more squares, in which these particles are arranged in ones, twos, threes and fours, symbolising the three states of aggregation, and a fourth, postulated by the author and called the "hyper-solid"; with a further element of matter called a "Kristallom," etc. All this somehow leads to a conclusion bearing more immediately on the subject of the book: that true solutions differ from sols in the source from which the energy required for dispersion is derived—this being the solvent in the former, and the disperse phase in the latter. Even if this distinction could be established by recognised methods, which seems improbable, it is not at all clear what diagnostic of systematic value it could possess.

It is difficult to conceive any class of readers who could derive from the perusal of this book any benefit at all commensurate with the time and effort required.

EMIL HATSCHEK.

OBITUARY

ALEXANDER SMITH

Prof. Alexander Smith, who died in Edinburgh, his native city, on September 8, three days before his 57th birthday, is known almost wherever chemistry is taught as the author of several text-books on chemistry of superlative worth. His "Introduction to General Inorganic Chemistry" and his "General Chemistry for Schools and Colleges" are particularly well known, but nearly all his works have been translated into German, Russian, Italian, and Portuguese. As these books attest, Alexander Smith was a great teacher: he had the gifts of personality, originality, and of lucid and stimulating exposition. Unfortunately he overburnt the candle of life—he was a most strenuous worker—and his early death leaves a gap that will be hard to fill; but his text-books are a legacy that will perpetuate his memory for many years to come.

Prof. Smith received his chemical education in the Universities of Edinburgh and Munich, where he graduated B.Sc. and Ph.D., respectively. His first important appointment was to the chair of chemistry and mineralogy in Wabash College, Indiana, which he resigned in 1894 to become professor in the University of Chicago, where, perhaps, his best work was done. In 1911 he became professor and director of the department of chemistry in Columbia University, City of New York, resigning this post about two years ago owing to ill-health. His scientific papers included original investigations on diketones, the benzoin reaction and on potassium cyanide as a condensing agent; and in inorganic and physical chemistry he did notable work on the liquid and amorphous forms of sulphur and the determination of vapour pressures. Among the honours bestowed upon him were election to the presidency of the American Chemical Society and conferment of the honorary degree of LL.D. of Edinburgh University.

WILLIAM KELLNER

Dr. William Kellner died in London on September 12, in his eighty-third year. Born at Frankfurt in 1839, he received his scientific training under Prof. Wöhler at Göttingen, where he eventually took his Ph.D. degree. In 1862 he came to England as assistant to Sir H. Roscoe at Owens College, Manchester, whence in 1861 he went to Woolwich and joined the staff of the War Department Chemist, then Sir Frederick Abel. In his early years at Woolwich Dr. Kellner was engaged in the varied general work of the Chemical Department. Later his main work became investigatory and experimental in connexion with explosives, and to meet the requirements of the various Commissions and Committees on which the War Department Chemist was a prominent member; of these the Royal Commission on Accidents in Mines and the Explosives Committee (appointed in 1889 to produce a smokeless powder for the Service) may be mentioned.

Dr. Kellner also devoted much work to the production of an apparatus for determining the flash-point of oils, and was largely responsible for the Abel flash-point apparatus, subsequently perfected; in collaboration with Sir Boverton Redwood he carried out an exhaustive series of tests with this apparatus.

As a scientific worker Dr. Kellner was painstaking and methodical, and he displayed much skill in devising experiments. His most important practical work was that undertaken at Woolwich in connexion with the evolution of cordite; in spite of the numerous smokeless powders which have been brought into use since, the fact that after a period of 30 years cordite still remains the British Service propellant for Army and Navy use, is perhaps the best testimonial to the thoroughness of his work in this direction.

In 1892 Dr. Kellner succeeded Sir Frederick Abel as Chemist to the War Department and, in addition to the duties of this office, served as an Associate Member of the Ordnance Board and as Consulting Chemist to the Royal Gunpowder Factory at Waltham Abbey. He retired from the Service in 1904. Kellner was one of the first Fellows of the Institute of Chemistry and served on its Council from 1895 to 1898.

Of an extremely modest and retiring disposition, the value of Dr. Kellner's work was little known outside his Department; he had a kindly and sympathetic nature, and his courtesy and cheerful optimism charmed those with whom he came into contact and won him a large circle of friends.

O. TRIGGER.

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REVIEW

Vol. XLI]

OCTOBER 31, 1922

[No. 20

INTERNATIONAL CONGRESS ON LIQUID FUELS PARIS, 1922

THE growing importance of liquid fuel renders necessary the standardisation of nomenclature and of methods of analysis. This was recognised some years prior to the war, and several International Congresses were held to deal with these important matters. It has remained for the Société de Chimie Industrielle to realise that the time was ripe for re-starting these annual meetings.

An International Congress on Liquid Fuels, and an Exhibition, were held in Paris, from October 9 to 15, in a building specially erected on the Esplanade des Invalides, under the direction of the Société de Chimie Industrielle and the presidency of M. Paul Sabatier. The success of this first Exhibition and Congress organised by the Society, is a proof of its activity and foresight. The chairman, M. Paul Kestner, and the secretary, M. Jean Gérard, are certainly entitled to the many congratulations they received upon the success of their arduous work.

The Exhibition was comparatively small but exceedingly interesting, and was remarkable for the comparatively large amount of space occupied by firms connected with the academic and scientific side of the petroleum industry. Many small Diesel and semi-Diesel engines were shown in action, and considerable business seems to have arisen from the Exhibition. Many types of burners and furnaces were shown, some in action, and great interest was taken in a small central-heating installation, in which very heavy oil was being burnt without the use of either compressed air or a positive pump for spraying the oil. On the scientific side there were exhibitions of refractory glasses of the Jena type, for one of which—the “Boromica” glass—it was claimed that the co-efficient of expansion was about 33 per cent. less than that of a Jena glass. Some new types of laboratory fractionating columns were shown, in which the column itself is protected by an outer jacket, which can be evacuated if liquids of high-boiling point are fractionated. Engines were shown that were running on fuels containing different proportions of ethyl alcohol.

The attendance, in spite of the counter attractions of the Motor Show, was on the whole very good, and towards evening the rooms were congested. The Exhibition was visited by several Ministers, and by the President himself. The keen interest taken by the heads of the political world in scientific and technical matters in France is in marked contrast to the apathy shown under similar circumstances in our own country.

The Congress was divided into six sections, and the principal matters dealt with in each section were as follows:—

1. *Petroleums*.—Distillation and distillation products of crude petroleum: motor spirit, kerosene, heavy oils, lubricating oils, paraffins, vaseline, etc., and their uses.

2. *Shales*.—Distillation and products of distillation: heavy and light oils.

3. *Lignites and Peat*.—Distillation and distillation products: benzols and tars.

4. *Coal-tars and Benzols*.

5. *Alcohol*.—Alcohol production, uses of industrial alcohol, and admixtures of alcohol with other combustible liquids for use as fuels.

6. *Vegetable Oils*.—Use of vegetable oils as fuels and as lubricants.

The Congress was formally opened on the morning of October 10 by M. Paul Sabatier, who briefly outlined its aims and gave a historical sketch of the problems requiring solution, showing both the necessity for fixed nomenclature and unified methods of analysis, and for the compilation of a systematic inventory of the world's resources in fuels. He pointed out that the reserves were not inexhaustible, and asked whether before they disappeared, and so upset the conditions of modern life, it would not be possible to produce combustibles synthetically, and on an industrial scale, utilising, as plants do, solar radiation for producing carbohydrates from water and carbonic acid. The results realised in chemistry, since the discovery of catalytic processes, gave great hope of the possibility of accomplishing this.

Prof. Daniel Berthelot dealt with the question of a national liquid fuel, which, as he pointed out, the war had proved to be a

vital one for all nations. France being an essentially agricultural country, the national fuel was alcohol, and the only question was, whether it could compete in price with petrol. He described the work of the scientific committee appointed to consider this subject, and gave reasons for the final decision that for the present mixtures of petroleum fuels with a certain amount of ethyl alcohol should be used. He referred to the various proposals which had been made to render ordinary commercial alcohol (95 vol. per cent.) miscible with commercial motor spirit in comparatively small proportions, such as the addition of butyl alcohol, isopropyl alcohol, cyclo-hexanol, "tetralin," ether, and the like.

The following two problems of an international character were put down for special consideration, namely:—

1. Terminology and characteristics of liquid fuels. 2. Analytical methods for determining these characteristics.

An international commission, appointed at the inaugural meeting to consider these problems, recommended that each nation represented should draw up a classified list of all commercial liquid fuels, together with exact particulars of their physical and chemical constants, as well as of the methods and apparatus employed for determining these constants, in accordance with a scheme approved by the commission; the lists to be presented for consideration to the Fourth International Conference of Applied Chemistry, to be held at Cambridge in 1923. A sub-committee was appointed to draw up a form to be used in furnishing the information for each individual fuel; this form was approved at the final meeting of the Congress. References were made to the work of the American Government Departments on testing methods and to that of the Standardisation Committee of the British Institution of Petroleum Technologists.

It can hardly be said that the organisation for the reading of papers was entirely successful. In the first place, frequently three meetings were going on simultaneously, and in the second place, the meetings were held in rooms within the Fuel Exhibition, and the noise of moving machinery and the roaring of oil-burners did not make for clarity in the proceedings. Then, again, the number of papers presented was far too great for the time available; at future meetings it would be advisable to have a selection or editorial committee to select the papers of outstanding interest for reading and discussion, the remainder merely to be printed. As it was, in Section I, between 9 and 11.55 a.m., ten papers were announced for reading and discussion. Many were not read in entirety, and many were not read at all; in consequence, one never knew at what time to be present to hear any given paper. All the papers will be published in a special

number of *Chimie et Industrie*, which should appear in November. Many of the papers in all Sections were compilations dealing with generalities, rather than original work dealing with specific subjects, a few were of the advertisement type, and some were of outstanding interest. As the official *précis* of the papers presented to the six sections occupies 30 pages of close print, in this place it is only possible to indicate their nature very briefly.

In the Petroleum Section Dr. J. P. Wibaut, of Amsterdam University, read a most interesting paper on the relationship between single and double linkages of the carbon atoms in hydrocarbons, as measured by the heats of combustion. From a technical point of view, M. A. Mailhe's paper on industrial and laboratory processes for transforming solid into liquid hydrocarbons, either by cracking or catalysis, was important. A paper by MM. H. Gault and A. Merle on petroleum in Madagascar was of considerable economic interest; experiments have shown the possibility of obtaining oils by distilling mixtures of local bitumens in special plant. Other papers dealt with petroleum from various sources, methods and apparatus for obtaining, testing, and using it. Two papers dealt specially with the production of petrol by the hydrogenation of heavy oils, according to the Bergius process.

In the Shales Section a paper by Admiral P. Dumas and Mr. Cunningham Craig urged the necessity for developing shales and bituminous peat, described the modes of their formation and the methods of mining them, and outlined distillation and refining processes. There were papers on the French shale measures, on those of the Lower Alps and of Esthonia, as well as on the various bituminous rocks of Syria, and also on the French shale industry and on new methods of distillation, etc.

The Lignite and Peat Section dealt with the lignites of Hérault, Aude, and of Serbia. Papers were also read on the low-temperature distillation of lignites and on the recovery of by-products. It was brought out in the papers, and in the discussion, that the French lignites can be as successfully worked as those of Germany; those of Hérault, for example, give 15 per cent. of crude oil, from which 25 per cent. of light oils, similar to benzol and petrol, can be obtained. A description was given of the French peat fields, and of methods of winning, treating and using the peat.

In the Tars and Benzols Section, papers were read on the production of benzol in the principal countries, on the treatment of tars and benzols as sources of liquid fuels, and on the subject of liquid fuels in relation to the low-temperature distillation of coal. The question of de-benzolising in small establishments was discussed by M. Baril, who explained that the technique was not well understood, because the law fixing a limit to the calorific value of gas was still before the Chamber, and, therefore, no one in France

was troubling to work out de-benzolisation on economic lines. Two other papers were read on the same subject. Modern methods of extracting benzol from coal gas were described as well as the manufacture of cyclo-hexanol, the hydrogenation of phenol by the platinum-black method, and the hydrogenation of naphthalene. The use of benzol and of naphthalene in connexion with the production of a national liquid fuel was considered.

The principal papers read before the Alcohol Section discussed the production of alcohol from vegetable materials and from ethylene; its use, either alone or in admixture with hydrocarbons in internal-combustion engines, and as a national liquid fuel. Other papers which proved of great interest related to the hygroscopicity of absolute alcohol, the preparation and use of alcohol in combustible liquid mixtures, the findings of the scientific committee on a national liquid fuel, and the trials in connexion with the use of alcohol in admixture with benzol, petrol and ether in the London General Omnibus Company's 'buses. A paper in this section which attracted great attention, was that by M. W. Vernet describing a new process (*Procédé Prodor*) for the production of alcohol by the acid hydrolysis of sawdust and cellulosic materials. Strong hydrochloric acid, both liquid and gaseous, is used, and the operation takes place at ordinary temperatures in a vessel which is constructed of an acid-resisting concrete, made of fine quartz and pitch. A yield of 250 litres of 100 per cent. alcohol per metric ton (56 gallons to the long ton) is stated to have been obtained in a semi-technical plant.

A series of papers was read before the Vegetable Oil Section on the production of these oils, and another series on their utilisation in internal-combustion engines, particularly in the colonies, where petrol is not available. Palm oil, groundnut oil and even castor oil can be used, but objections were raised in regard to their acidity and consequent action on the cylinders and valves.

The proceedings terminated with a most interesting lecture by Professor Mailhe on the production of petroleum bodies by the hydrogenation of vegetable oils. The possible bearing of this on the theory of the origin of petroleum was briefly referred to.

The social side was by no means neglected. The delegates were received by the Committee of Organisation at the Palais d'Orsay on the evening of Monday, October 9, and on Tuesday evening at the Hôtel de Ville there was a reception by the President of the Municipal Council. On Saturday evening the delegates were invited to a banquet at the Palais d'Orsay, where the chair was taken by the Minister for Public Works, who referred to the interest taken by the French Government in the subject which had been discussed by the Congress, and whose importance was not only national but world-wide.

THE COLLOID MILL

A. FORSTER and J. REILLY

ACCORDING to Svedberg, the preparation of colloidal solutions can be grouped under two general headings: (a) the condensation method, depending on the building up of disperse particles from molecules; (b) the dispersion method, in which the solid material is scattered throughout the liquid by various means. There is a large literature on the technical preparation of these solutions by (i) chemical reactions, which can be classified under either (a) or (b), and (ii) electrical methods which come under grouping (b). It is curious, however, that mechanical means to disperse materials have not been employed technically, except on a limited class of substances until a comparatively recent date. In the present review attention will be confined to a recent development of this method of producing colloids.

For many chemical and technical purposes it is often necessary to reduce materials to a certain degree of division, and recently much attention has been given to the evolution of disintegrators and so-called "colloid" mills—machines for greater efficiency and new effects in fine grinding. The method employed is the application to the material of a high-power blow, either direct as in ball- and hammer-mills, or by throwing the material at a high speed against a resistant wall, as in throw-mills. The limitations of dry grinding, however, even with these machines, have long been realised, owing to the resistance of the air, the development of frictional heat, and the necessity for ventilation. Consequently, in mills aiming at maximum division the material is suspended in a liquid—usually water. In the disc-mill—perhaps the best known of these—the material in an aqueous suspension is fed into the centre of two discs in rapid revolution, either in the same or in opposite direction, and becomes disintegrated by its friction against the discs while being forced centrifugally to their edges. Another general form is the "dismembrator," in which the material in aqueous suspension is fed on to the axis of a high-speed revolving arm-wheel, surrounded by a number of close-fitting baffles.

Recently Dr. Plauson and his co-workers have published papers and patents* claiming the attainment of new effects in mechanical milling, whereby ultra-microscopic suspensions of particles less than 0.001 mm. diameter, which show the characteristic Brownian movement, are readily obtained with a wide range of sub-

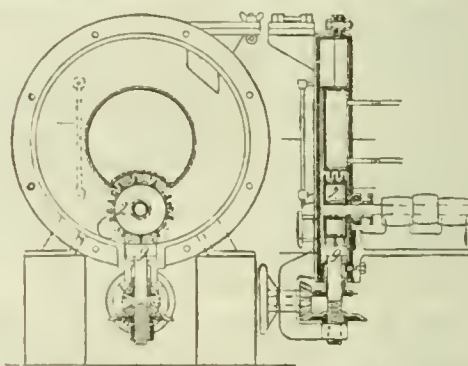
* Z. angew. Chem., 1921, p. 25; p. 469 c.f. Die Kolloidmühle u. ihre Anwendungsmöglichkeiten, H. Plauson, Z. angew. Chem., 34, 1921, p. 469-473. Die Kolloidmühle u. ihre Verwendung f. d. Chemische Grosstechnik, B. Block, Z. angew. Chem., 34, 1921, p. 25. Eng. Patents 155,836, 156,140, 156,142-3-4, 156,149, 156,124, 156,137, 156,150, 156,189-9, 156,138, 171,084, 183,908, 184,532. D.R.P. 314,560, 327,575, 329,593, 331,348, 337,429, 337,437.

stances. Two types of mill have been employed. One is a disc-mill in which is applied (a) an adjustable pressure to the suspension passing through the discs, (b) a continuous circulation of the milled suspension, and (c) a rapid counter-revolution of the discs at 2000 r.p.m. The other mill consists in principle of a "dismembrator," in which Plauson's innovations are (1) the rotating arm-wheel is placed eccentrically towards the base of the containing case so that the material continually falls into the field of action instead of circulating centrifugally outside the arm-wheel range, (2) the reduction of the baffles to the minimum number—two for balance—in order to obtain a maximum force at each; in the ordinary dismembrator the force is divided over a number of baffles; (3) the application of extremely high speeds of revolution.

Plauson has embodied his modifications of the dismembrator mill in a standard design, generally known as Plauson's Colloid Mill, as shown in the diagrams. The standard size of this mill is 15 litres capacity, but larger sizes have been built. The containing case is a circular body of cast iron (or other suitable metal), the front being detachable on horizontal arms for inspection and repairs. The body is double-eased in the casting, the cavity being arranged for heating or cooling. The beater-wheel is mounted on a horizontal shaft (ball bearings) eccentrically placed. It consists of several armed discs of special quality steel bolted together. The arms pass closely with 1 to 3 mm. clearance through gaps in the stationary baffles (or anvils) above and below the axis of the revolving shaft carrying the beaters. The number, width, arrangement and clearance of the teeth may be varied. The beater-wheel and the two baffles almost fill the lower part of the mill case; in the upper part are feed-holes, level-gauge, sight-glass, cooling coils and steam-inlet. As an additional effect perforated baffle-plates are arranged co-axially with the beater-shaft in order better to retain the material within the area of the beater-wheel. The arm-wheel is rotated by a belt-drive up to 3000 r.p.m. The material in suspension is added through an inlet into the case, and, becoming engaged by the revolving wheel, is subjected to the forces between the wheel-arms and the baffles.

The arm-wheel at its high speed of revolution (3000 r.p.m.) may be considered to be running in a highly cavitated fluid offering small resistance, thus avoiding much of the loss of power experienced in some other mills by undue friction. The surrounding liquid suspension is said to be continually thrown towards the arms of the rapidly rotating wheel. The particles in suspension in this liquid receive a powerful blow either directly, or through the liquid between the travelling arm and the water behind it, at such a velocity as to shatter them before any of the force can be dissipated,

thus utilising the short-duration high-energy impulse transmitted through the water. The disintegrating action of this mill is probably, in the main, mechanical. The use of the enclosing baffles is to impart an increased pressure to the liquid being forced through it by the travelling arm. Stress also is laid upon the function of the force of each individual blow in the disintegration of particles, and distinction is made between the positive results in this direction effected by a powerful force of short duration, and the negative results of a smaller force over long periods. Thus, for each substance there is a minimum impulse, that is, in the colloid mill, a minimum rate of revolution of the arm-wheel, below which disintegration cannot be achieved. This critical or specific rate of revolution depends upon the hardness, elasticity, and strength of the material, and ranges roughly from 3000 r.p.m. upwards. In preparing some emulsions, it is stated that excessive speeds have a coagulating effect. In certain cases temperature, too, it is stated, must be kept within certain limits for the best results.



Sectional View of Mill: Front and Side Elevation.

In almost every colloidal preparation, however, the mechanical action of this mill is assisted by the addition of "dispersators" or "accelerators," which are claimed to be necessary for the preparation and permanency of many colloids. Their purpose is, by physical or chemical means, to allow or accelerate the disintegration of the particles and reduce the power consumed by the mill. Theoretically, their function is to absorb or to precipitate soluble electrolytes always present, although sometimes only in traces, in the material being reduced to the colloidal state. Actually, they appear to act as protective colloids. These accelerators cover a wide range of substances, as may be seen in the patent literature quoted. Another use claimed for the mill is the fractional disintegration of mixtures of substances of different hardness, enabling a ready separation of the less disintegrated ingredient by settling.

During a recent visit to Plauson's Research Institute, at Hamburg, a 15-litre mill, running at 3000 r.p.m., was inspected, and some experiments were carried out with this mill. A great

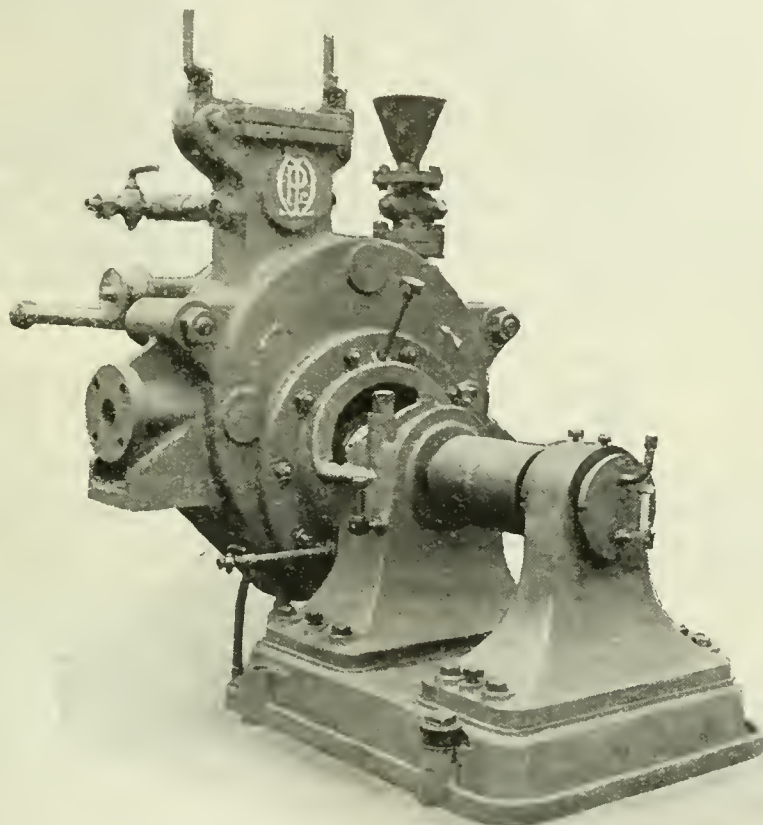
variety of products made in the mill was seen. The specimens approximate to the list attached.

For the manufacture of colloidal solutions, it is proposed to run the mill as a continuous operation. Many substances are said to be sufficiently quickly dispersed in the mill as to be capable of being run continuously through at a comparatively rapid rate. With more resistant material a continuous process is aimed at by the use of a number of mills in series.

be run off from the gauge-glass. The product, after passing through the mill, runs off continuously from the base outlet.

In some cases it is not considered economic to aim at a complete disintegration of the material in one set of millings, but to allow the non-colloidal material to settle out for milling in a succeeding batch.

If the milling continues over several minutes, a rise in temperature takes place. In the majority of cases this heat is stated to assist



Complete Mill, showing Setting of Shaft.

The material to be milled must first be ground in ordinary mills, ball-mills, etc., since the colloid mill cannot deal with particles too large to be caught in the small clearance between the wheel-arms and the baffle-sides. After preliminary grinding, it is then made into a suspension with water (or other liquid), in suitable proportions not exceeding the specific saturation. The accelerator, the nature and amount of which depend on the colloid to be prepared, may be added at this stage, or simultaneously run into the mill. The suspension is then run continuously into the top of the mill, the beater-wheel of which must exceed the critical number of r.p.m. for the material being milled. During the milling the sight-box provides a view, and samples may

disintegration, but sometimes it is a disadvantage which must be obviated by a flow of water through cooling coils in the upper part of the machine. In some cases the injection of steam into the machine facilitates the disintegration.

Thus, a Plauson-mill installation would usually include preliminary crushers or breakers, pre-grinding mills, sieves, storage and mixing tanks for water, accelerator and suspension, and settling tanks for the milled product together with elevators, conveyors and dust catchers. When the colloid has to be separated special filters and driers might also be required (E.P. 155,834).

The output and power consumption of the mill depend on the ease of disintegration of the

material, the extent of disintegration, and the rate of revolution of the mill. It is stated that three 15-litre machines in series, running at 9000 r.p.m., can grind 1000 kg. ground "raw phosphate," or 200 kg. cellulose in an hour to such a state of division that 85 per cent. of the particles is estimated to be of the order of 0.001 mm. diameter. Exact figures of power consumption have not been obtained. It is understood that with the older type of 15-litre apparatus for tar oil the power consumption was of the order of 1 h.p. per 33 kg. of material disintegrated, and with calcium phosphate of the order of 1 h.p. per 5 kg. of material treated. These figures are only very approximate and with the new machines, fitted with baffles, etc., and possibly run at higher speeds, a much greater output per h.p. is claimed.

For convenience the industrial uses claimed for the colloid mill have been divided into four groups. The following is a brief outline, under these headings, of the industrial uses claimed:—

I. THE PREPARATION OF PLASTIC MASSES

Raw material	Use
Sawdust-waste, wood-meal, mica waste (with resin, etc.)	Insulators, buttons, etc.
China clay	Filling, etc.
Slag	Road bricks, porous bricks
Shale residues	Bricks
Rubber waste	Regeneration and moulding
Gelatin, casein, starch	Masses (buttons, etc.)

II. THE PREPARATION OF COLLOIDAL SOLUTIONS FOR DIRECT USE

Raw material	Use	Remarks
Sulphur	Disinfectant, spraying on plants	Rapidly absorbed
Creosote	Do., general	Avoids precipitation by dilution
Metals Cu, Mn, Ag	—	Form of disinfectant
Phosphate	Fertilisers	Rapidly absorbed without sulphuric acid treatment
Felspar	—	—
Milk (condensed)	Formation of milk (substitute)	—
Tar	Road spraying, etc.	Saves heating
Asphalt	—	Saves solvent for exporting abroad. Increased efficiency
Scents	Scents	—
Essential oils	—	—
Mineral and organic pigments	Inks	New pigments can be used
Graphite	Lubricants	Enhanced lubrication, avoids overheating of lubricant and charring
Oil (grease)	—	—
Water emulsion	—	—
Resin (in water)	Polishes	Saves solvent
Vasellines	—	—
Shellac	Lacs	Saves solvent
Resin, size, cellulose esters, copal, Bakelite, rubber	Enamels, etc.	—
Ultramarine	Paints, etc.	—
Metals and alloys (bronze)	Paints, etc.	—

III. THE DIVISION OF MATERIALS FOR CHEMICAL ACTION

Raw materials	Use	Remarks
Fats	Soap	Cold saponification
Nitro-compounds	Dyes, etc.	Cold reduction to amino-compounds
Nickel	For hardening oils	—
Peat	Permentation	Rapidly assimilated
Cellulose	Viscose	Reduces amount of reagents
Cellulose	Glucose	Dilute acids, higher yield, avoids decomposition by acids
	Fermentation	—

IV. THE SEPARATION OF MIXTURES BY FRACTIONAL DISINTEGRATION

By suitably adjusting the speed of the mill and the type and amount of accelerator, intimate mixtures are fractionally disintegrated; and if the milling be suitably timed, a separation of one ingredient in colloidal solution from another in coarse suspension by simple screening through fine mesh sieves can be made, as for example:—

Application	Remarks
Dyes	Brown pigment removed from Royal Blue, etc.
Metallic ores	Metal from rock
Clay	Kaolin from silica
Shales	Oil from mineral
Bituminous coal	Montan wax

For the formation of emulsions, and the rapid, continuous, fine disintegration of soft colloidal solids, such as china clay, graphite, dyes etc., the mill offers possibilities.

In conclusion it may be said this colloid mill is sufficiently suggestive to justify a recommendation to manufacturers to put it to the test in every possible direction.

ATMOSPHERIC DUST*

The results referred to in this paper have been obtained by the aid of a new instrument for measuring atmospheric dust. This instrument has already been fully described elsewhere,† and therefore a very short description of the method will be sufficient for the present purpose.

The instrument is based upon the facts that atmospheric moisture can be condensed by a reduction of pressure and that such condensation occurs around the dust particles as nuclei. The principle is utilised by J. Aitken,‡ but in Aitken's dust-counter the actual particles counted are the drops of water, and as it is now known that condensation can occur round nuclei other than dust, the counting of such drops does not give the information required.

In the instrument referred to here the reduction of pressure and temperature is brought about by impressing a very high velocity on the air in a small jet. The jet travelling at its maximum velocity, i.e., that of sound in air, has its pressure reduced by the loss of "velocity head," and condensation takes place; as the jet is caused to strike a microscope cover-glass placed 1 mm. away from the opening, the dust particles striking the glass adhere to it by virtue of the condensed water, which is then evaporated as the air flows away, leaving the dust behind.

In the actual instrument a ribbon-shaped jet is used, 1 cm. long and 0.1 mm. thick, and the efficiency of this, when used under suitable conditions, has been found to be extremely high. The air before entering the jet is caused to pass through a damping chamber to provide sufficient water.

The nature of the record obtained is a linear deposit of dust which can be examined microscopically or micro-chemically, and the number of

* Paper read by Dr. J. S. Owens, before Section B (Chemistry) of the British Association, Hull, 1922.

† Proc. Roy. Soc., A. Vol. 101, 1922

‡ Trans. Roy. Soc., Edinburgh, Vols. 30-36.

dust particles counted. If sufficient air is drawn through the instrument a thick deposit of dust will be obtained, and if during the process the damping chamber is slightly warmed, excess water will be condensed and this dust deposit will be washed by the condensed water, with the result that on the record itself dried-up stream beds will be found flowing out laterally. In these streams crystals of the soluble salts contained by the dust are to be found. The dust particles are counted by means of a net-ruled micrometer eye-piece with millimetre squares, and by the use of this a few strips across the linear record may be counted and an average obtained which, multiplied by a factor depending upon the length of the record and the volume of air taken, will give the number of particles per c.c.

NATURE OF DUST OBTAINED FROM THE AIR

Size.—Most of the records taken to date have been in London, but a fair number have also been obtained in country districts and at sea. It has been found that the particles composing a smoke fog in London are curiously uniform in size and rarely exceed 1 micron in diameter, the average size being about half a micron.

Shape.—The particles vary in shape, and are usually irregular but with somewhat rounded outlines.

Composition.—It is somewhat difficult to ascertain the true composition of this suspended dust, but certain means are available such as crystallographic and micro-chemical methods. The suspended matter in London air can be definitely stated to consist mainly of soot. It has been possible, for examples, to volatilise from a record quite a recognisable quantity of tar. From the presence of sulphur in coal and coke smoke one would expect to find crystals of sulphates in the air of cities, and this has been found to be the case.

In country districts the dust obtained by means of this instrument is quite unexpectedly large in quantity under certain conditions; notably during the bluish haze which is often found over practically the whole of England with certain types of weather. This impurity is doubtless derived from cities. It is black in colour, contains some soluble salts, and is very finely divided, the size of the particles averaging about half a micron in diameter. The existence of a haze overlying a country is not, however, a proof of the presence of smoke, as I have found a similar haze at sea when nothing could be obtained from the air but crystals, presumably of sulphates. Again, a record taken in Algarve, in the south of Portugal, last March showed that a haze which existed at the time was composed practically entirely of common salt.

The nature of the dust suspended in the air is of considerable importance from many points of view:—In a haze consisting of salt crystals it is obvious that there would be a marked tendency to fog with a smaller increase of humidity of the air than would otherwise be required; due, for example, to fall of temperature. Doubtless in many cases the presence of such crystals suspended in the air is a fruitful cause of fogs. The dust, however, which is found over the country in England is quite different. It is mainly insoluble in water and the amount of crystalline salts contained is very small. This dust interferes with visibility, and one cannot help feeling that it is not conducive to health to breathe air containing several thousand insoluble

particles per c.c., as is often the case during a comparatively light haze.

Microchemical Examination.—The attempt to produce crystals from the records, as already indicated, is one of the means available for examination; the crystals can then be examined microscopically for shape, and under polarised light; they can also be examined chemically by using minute quantities of reagents, but the excessively small size of the crystals, even when obtained, makes their recognition somewhat difficult, for the crystals rarely exceed a few microns in length and there is also the tendency to form imperfect and skeletal crystals. Records taken on cover-glasses treated with dilute solutions of an indicator, such as methyl orange, show that the dust is sometimes acid and sometimes alkaline.

Practical Bearings.—The importance of dust in the air from the standpoint of public health is well recognised, and to fix permissible standards of dust pollution it is essential to have a means of measuring it and of obtaining samples for examination. Again, in the study of visibility and factors affecting it, there appears to be little doubt that the presence of suspended impurity, other than water in the air, has a profound effect, and is, indeed, the governing factor. The whole question of visibility and its measurement is one requiring careful investigation since the present methods of measurement are very crude. There is little doubt that parallel measurements of visibility and dust pollution would show a definite relation between them, as, indeed, I have demonstrated.*

Another practical use for this instrument is in the testing of air-purifying plant. There are many forms of so-called air-purifying plants but few of them produce anything like the effect intended or claimed, and the methods adopted for examining their efficiency have been so unreliable as to be of little use. It is now possible, however, by the aid of this instrument, to state what is the percentage efficiency of an air-purifying plant; to say, for example, out of every 100 particles of dust in the air entering the plant how many penetrate through.

There is, again, a bearing upon the question of condensation of water from the air. It has long been held by some authorities that the initial stages of condensation take place round hygroscopic nuclei composed of soluble salts or even of sulphuric anhydride, and that the haze which we often see in the mornings, and which has already been referred to, consists of minute drops of water condensed round such nuclei. This is a question of fact rather than one of theory, and given a sufficient number of hygroscopic nuclei in the air there is no doubt condensation would initially occur upon them. The question is, however, are there a sufficient number present, and does the haze referred to consist of liquid? I think this question can now be answered fairly definitely: in some cases there are quite sufficient hygroscopic nuclei present and few or no solid dust particles, in others the reverse holds good, and the suspended matter consists mainly of insoluble dust. By the use of the instrument referred to, I have demonstrated that the haze over the country in England during a fine summer's day consists of insoluble dust and not liquid.

*Proc. Roy. Soc., A. Vol. 101, 1922.

Electrical State.—There is a method of examining the electrical condition of dust suspended in the air which has been adopted by Millikan and others by which the suspended particles are examined microscopically while in the field between two charged electrodes, one positive and the other negative. In such a field the dust particles sort themselves out, the positively charged moving towards the negative, and the negatively charged towards the positive electrode, neutral particles being unaffected. Tobacco smoke examined in this way shows a mixture of positively and negatively charged particles with some which are neutral.

In order to examine this effect a simple apparatus has been devised which consists of a vulcanite cell, 2 or 3 mm. deep and about 1 cm. in diameter, which contains two insulated electrodes connected to terminals on the outside. The cell can be placed upon a microscope slide and closed above by a cover-glass. Such a cell illuminated by the dark-ground method, and examined under a comparatively low power, say a $\frac{3}{4}$ in. objective and $\times 10$ eyepiece, shows the particles of tobacco smoke suspended in the air between the electrodes, each particle in rapid Brownian movement. By charging the electrodes the movements of the particles can be examined. The cell is illustrated in Fig. 1, and it is hoped that by its use it may be possible to ascertain the electrical condition of London fog particles.



FIG. 1

SOURCES OF DUST

The common sources of dust are the smoke from imperfect combustion and dust blown up from the ground. There are other sources whose importance has not yet been ascertained; the most probable seem to be volcanic, cosmic, and solar. It is well known that the finer particles of dust ejected during volcanic eruptions may remain in suspension in the air for many months; again, the arrival of dust from outside the earth's atmosphere, either of cosmic or solar origin, would tend to bring about a concentration in the lower strata of the air, since the rate of settlement of such particles through the air would be continually reduced owing to the increasing density of the air near the earth. An extract from the *Barbados Advocate* of May 23, 1922, was referred to in the *Meteorological Magazine* of July

last. This is of great importance in the present connexion and reads as follows:—"A peculiar phenomenon which has spread over the whole Caribbean from Barbados to St. Kitts, and extending south almost to Demerara, has been the prevalence of a low-hanging mist which has shut off the horizon. For some time the idea prevailed that it was dust due to volcanic eruption, but this was removed by the reports from vessels arriving, and from advices, from the neighbouring islands. Captains trading in these waters for years state that they have never before experienced such continued low visibility at this time of the year. No scientific explanation of the phenomenon has yet been offered."

Dust from space outside our atmosphere would naturally be drawn towards the earth when it came within the sphere of the earth's attraction, and there is little doubt that some, at least, of our dust comes from this source. There is again the projection of dust particles from the sun under the action of light which may also account for some of the dust in our atmosphere. The latter source has been dealt with by Fleming* and others.

In this connexion the presence of spherical particles mixed with the ordinary irregular dust particles is suggestive, and although a small proportion of such particles is nearly always found in the dust records, sometimes the proportion rises considerably, so that a very large percentage of the dust particles found consists of apparently perfect spheres, usually transparent and varying in diameter from 1.5μ downwards. For example, early in March last the proportion of such spheres commenced to increase and towards the end of the month reached something like 50 per cent. of the dust particles in London air. The number of these and their distribution were investigated by Mr. G. M. Watson, the Advisory Committee's research chemist, and the result of this investigation is given below:—

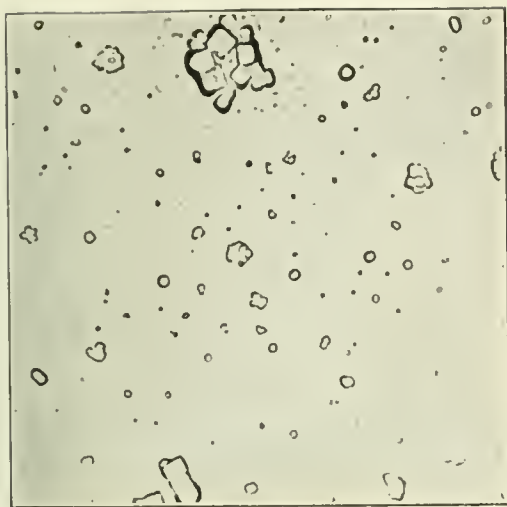
The presence of an unusually large proportion of spherical particles in the dust of the atmosphere was first noticed on March 16, 1922, when, from a record taken with the jet instrument in Westminster, it was found that quite 50 per cent. of the particles was spherical. Many were apparently colourless and transparent, similar in appearance to air bubbles in a liquid, and as much as 1.5μ in diameter, i.e., three times as large as normal fog particles.

The presence of large spheres is not unusual since they are produced during combustion in certain types of industrial furnaces, but never before had such numbers been found. In an investigation carried out in the neighbourhood of such a furnace, 90 black spheres per c.c., together with 7700 smaller particles, were detected, the diameters of the spheres ranging from 0.75 to 1.8μ .

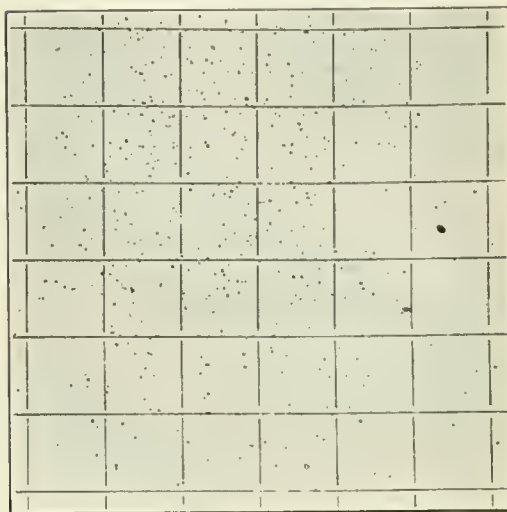
On another occasion 64 spheres, of diameters from 0.75 to 1.5 , with 3800 particles of an average diameter of 0.5μ were found per c.c. These results, however, were obtained near a chimney from which spheres were constantly emitted, and all the particles were opaque and black.

A local source of the spheres was suspected in Westminster, but records taken on March 18 and 19 in Surrey, 12 miles from London, showed a similar abnormality. Records taken on March 26, 20 miles

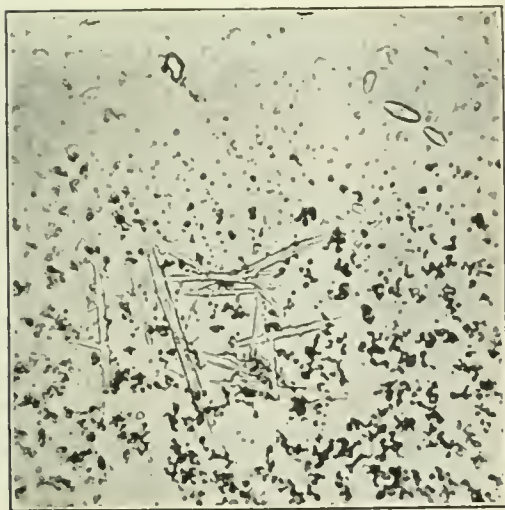
**Jour. Roy. Soc. Arts*, Vol. LXX, No. 3004.



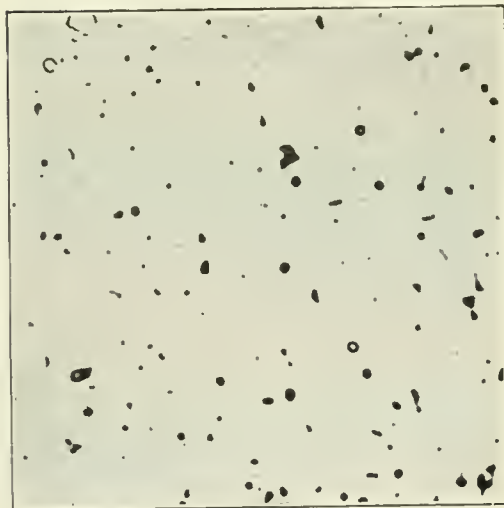
Haze of Salt Crystals,
Algarve, Portugal.
Magnification—1000 diameters.



Record of London fog, taken on Sunday, November 27, 1921,
showing the squares in eye-piece used for counting particles.
Magnification—approximately 250 diameters.



Suspended matter brought across the North Sea from the
Continent, showing crystals and smoke particles. Record
taken on East Coast of Norfolk, August 19, 1921. Each milli-
metre of linear record contains dust from 1000 c.c. of air.
Magnification—1000 diameters.



Dust from London air showing spherical particles—Sunday,
March 26, 1922. Wind from N. Each millimetre of linear
record contains dust from 5 c.c. of air.
Magnification—2000 diameters.

north of London showed the same phenomenon, when the wind was from the North. The investigation was therefore continued, records were taken under conditions as varied as possible, and many back records were re-examined with a view to ascertaining:—(1) Nature of the spheres; (2) first occurrence in abnormal quantities; and (3) subsequent distribution.

Appearance of Particles.—Every examination was carried out under a 1/12 in. oil-immersion objective, a magnification of at least 1200 diameters being essential. Whereas the majority of the particles seem solid and opaque, the larger ones appeared as black circles, each with a bright spot in the centre. The width of the bounding rim could be altered and the bright centre moved slightly from side to side by varying the illumination. The smaller the particles, the smaller were the bright centres, and at a diameter of 0.75μ the spots disappeared and the particles appeared entirely black. Occasionally reddish brown spheres were found.

The term "transparent sphere" will be here reserved for the particles large enough to show a bright spot in the centre, although the small black spheres may be made of the same material.

When an object, such as a pencil, was interposed between the source of illumination and the microscope-condenser, each transparent particle behaved as a lens, producing a sharp, recognisable image of the object. For instance, it was easy to distinguish between the square and pointed end of a pencil by examining the images produced in spheres of 1.5μ diameter. Images of the thin supports of a stop in the carrier of the condenser were perfectly definite, about half a micron above the spheres, showing that they were composed of a transparent glassy material and their appearance was not a spurious effect due to diffraction. The dust was mounted dry; thus bubbles were impossible.

When mounted in xylol, Canada balsam, cedar-wood oil, or water, the transparent spheres altered in appearance but did not dissolve. This was established by focussing upon a particle and allowing the liquid to flow under the cover-slip until the sphere was immersed. The spheres then appeared less conspicuous and the bright centres became smaller. From the movements of the boundary, when focussing on a sphere mounted in balsam, it was concluded that the refractive index of the material was slightly less than that of Canada balsam—1.54. The particles were not hygroscopic. After being kept for some weeks several records became covered with drops of moisture, but there was no tendency for them to form round the spheres more than on other parts of the cover slip. Occasionally spheres were enveloped in the drops, but they remained undissolved. The spheres had no effect whatever on polarised light, and mounted in blue glycerin jelly showed no tendency to take up the stain. The effect of heat was never attempted, as this was impossible under the microscope.

Quantitatively the problem was much more difficult and the results can be taken only as a rough guide, for the following reason:—No distinction is possible between transparent spheres and black spheres, the one passing into the other at a diameter depending somewhat upon the illumination, thus introducing a personal element. Moreover, there is a limit to the resolution of the microscope, and below a diameter of 0.3μ , every particle appears spherical—a spurious effect due

to diffraction. Thus, if true spheres and irregular particles were present together, distinction would depend entirely upon the size of the irregular particles. In general, spheres classed as transparent were of a diameter of 0.9μ or over. In estimating the number of black spheres, all particles above the limit of resolution which were obviously spherical and not large enough to appear transparent were counted.

The type of result will be best illustrated by a particular case. On April 5 last, at 4.30 p.m.:—

Total number of particles per c.c.	2,400
Number of transparent spheres definitely greater than 0.9μ	26 per c.c.
Number of spheres greater than 0.75μ but not all transparent	50 per c.c.
Very many spheres	1.2 μ diam.
Few small particles, estimated as 10% below limit of resolution. All above limit appeared spherical. Therefore 90% called spheres.	

Results.—Table I shows some typical results selected after examination of a large number of records.

TABLE I

Date (1922)	Time (summer time)	Total No. of particles per c.c.	No. of transparent particles per c.c.	Percentage of transparent spheres	Estimated % of all spheres	Place of observation
Mar. 18	Afternoon	1200	66	5.5	100	Cheam, Surr'y
" 20	1 p.m.	17,200	410	2.38	—	Westminster
" 20	4.30 p.m.	8,450	212	2.60	—	"
" 26	1.45 a.m.	5,200	106	2.23	50	Bloomsbury
" 27	12.45 p.m.	5,100	80	1.57	50	S. Kensington
April 1	10.10 p.m.	4,500	53	1.18	50	S. Kensington
" 3	3.45 p.m.	14,100	159	1.13	—	Westminster
" 5	4.30 p.m.	2,400	26	1.08	40	S. Kensington
" 9	12.30 p.m.	9,440	146	1.54	50	Bloomsbury
" 17	4.30 p.m.	1,960	10	0.51	50	Grimsby, L'cs.
" 29	6.30 p.m.	6,120	80	0.13	100	S. Kensington
May 3	6.30 p.m.	8,530	0	0	20	Westminster
" 6	5.30 p.m.	2,580	40	1.55	90	S. Kensington
" 9	12.15 p.m.	2,610	26	0.99	50	"
" 25	4 p.m.	3,480	0	0	10	"

The only definite conclusion which can be formed is that about March 4 there appeared in the air some abnormal particles, reaching a maximum about March 18, followed by a slow return to the normal. The spheres were not confined to one district and therefore, presumably, the source was not local, yet there was apparently a distinct variation with the smoke content of the air. If the source were extra-terrestrial the number of spheres might be expected to be independent of other particles, which is clearly not the case.

On consecutive days, at corresponding hours, there are great variations in the smoke content of the air of cities. This does not imply that on one day more smoke is produced than on the other, but that on some days meteorological conditions do not permit of its removal. If the conditions which prevent smoke from rising would also tend to bring down any impurity from the upper air due to a distant source, this might account for the relationship between the spheres and smoke particles above indicated.

Attempts to correlate the number of spheres with other particles were made on May 8, 9, and 11, when series of records were taken at the same place throughout the day. The results were not conclusive, since the spheres were not sufficiently numerous to give a reliable indication, but there was no evidence of any definite relation to the number of other particles. In 10 cases out of 11 the number of transparent particles per cubic centi-

metre was 13, whereas the total number of particles per c.c. varied from 1850 to 5750.

Fig. 2 shows the daily percentage of transparent spheres, and if the spheres and smoke particles had the same origin we should expect the percentage to remain fairly constant, whereas it varies considerably.

Variation of Transparent Spherical Dust Particles in Air

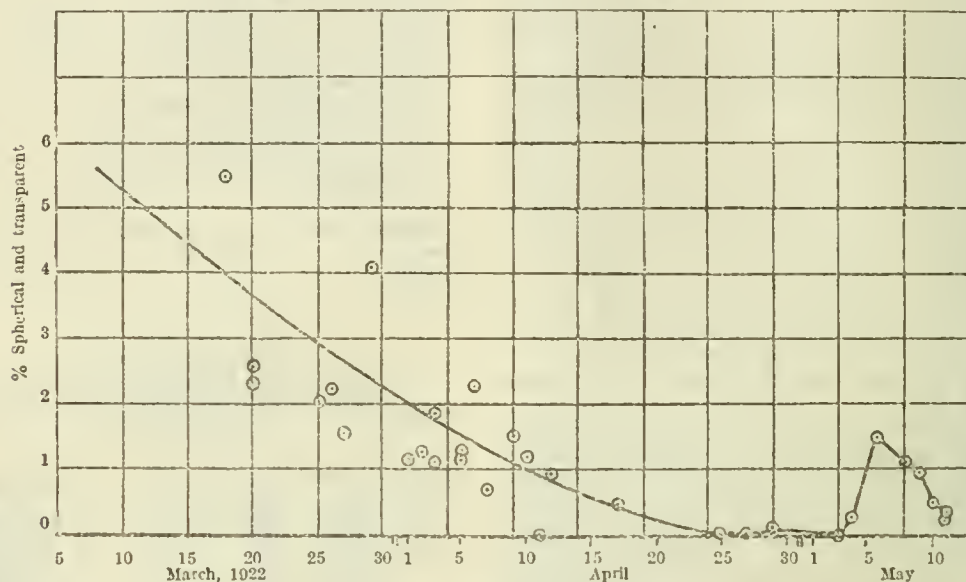


FIG. 2

Origin.—Some of the possible explanations of spherical particles in the air are as follows:—

- (1) Micrococci; (2) spores of fungi, or pollen grains; (3) drops of oil or of solutions; (4) furnace ash; (5) bits of crystal too small to show definite shape; (6) organic matter synthesised from CO_2 and H_2O by radio-activity; (7) cosmic or solar dust; and (8) volcanic dust.

Considering each of the above separately, we may dismiss most of them as unlikely in the present case.

(1) Micrococci should show more uniformity of size than the spheres noted. They should presumably be independent of, or vary inversely with, the smoke content of the air, and should be capable of staining. The presence of micrococci could not explain the sudden increase of numbers in March and subsequent decrease. Micrococci are also of large diameter.

(2) Spores are rarely less than $12\ \mu$ and pollen grains than $25\ \mu$ in diameter. The particles noted never exceeded $2\ \mu$. Spores are capable of being stained and would not account for the increase in March.

(3) Drops of oil or solutions would be soluble in xylol or water.

(4) Industrial furnace smoke would not produce large variations in the percentage of spheres on different days and gives no explanation of their comparative absence before March 4.

(5) Crystals below a critical size are spherical in shape and these spheres may be minute crystals of insoluble matter. But they have no effect upon polarised light and show no tendency to grow together. Further, this will not explain the increase in March.

(6) Formation of globules of carbohydrates by radio-activity has been described.* This would not explain the increase in March and the variation with smoke content of the air.

(7) Cosmic dust. This is a likely explanation but does not account for variation with smoke content. If the whole of the upper air were full

of spheres they should be detected all over the world. This was not noted. Records taken in Portugal in April contained no spheres.

(8) Volcanic dust is the most probable source. This is known to travel great distances (compare Krakatoa, 1883), and for some time before March there was great volcanic activity in Europe. Particles of material thrown molten into the air would assume a spherical shape and cooling quickly would remain structureless.

In verification of the volcanic dust theory, a sample of the finest dust collected at Krakatoa after the eruption of 1883 was examined.

Only the larger particles which had settled near the volcano were available and so a comparison with the minute spheres obtained in the jet-apparatus records was hardly correct, though information which may throw light upon the nature of the material of the spheres was obtained. Nearly all the particles consisted of thin flakes of colourless, glassy material with a finely pitted surface, broken into irregular angular pieces. The appearance suggested fragments of thin-walled bubbles blown in molten glass. The size of the pieces ranged up to 18 microns, the average being about $12\ \mu$. Very few were smaller than $3\ \mu$, but there were some spheres of diameter $1.2\ \mu$, identical in appearance with the unknown atmospheric dust. There were also a few perfect spheres with smooth surface of about $5\ \mu$ diameter, some appearing reddish-brown in colour.

When mounted in Canada balsam the large irregular particles disappeared, the refractive index being the same as that of balsam. Their positions

* Harrison Glew, *Nature*, June 3, 1922, 714.

could then be distinguished by the fact that many of the marks on the surfaces were really adhering particles, which in balsam stood out as black spheres up to $1.2\ \mu$ diameter. These were not air bubbles in the balsam, as they were quite different in appearance. Occasionally black spheres up to $3.5\ \mu$ diameter, made more obvious by the disappearance of the irregular pieces, were also seen, affording support to the theory that the particles described above were of volcanic origin.

The photographs given illustrate some of the records obtained by the instrument referred to.

The following are typical counts of recent records which afford comparison of the state of the air in different localities:—

TABLE II

Date, 1922	Place	Time (summer time)	No. of smoke particles per c.c.	Remarks
Sat., Sept. 2	Holme, Norfolk	12 noon	152	Country air, no chimneys near
Tues. „ 5	Brighton	12.10 p.m.	1,380	Wind NE'N.
Thur. „ 7	Hull, near Victoria Pier	7.30 a.m.	4,830	Thick water fog
Fri. „ 8	Do.	7.15 a.m.	8,100	Wind NE'N. Smoke haze
Sun. „ 10	Do.	6.30 p.m.	3,080	Wind NE'N. Air obviously clearer
Mon., „ 11	Do.	7.30 a.m.	13,800	Wind W. Thick smoke haze
„ „ 11	Outside Spurn Point	4.30 p.m.	140	Haze visible over land

SOCIETY OF CHEMICAL INDUSTRY

ANNUAL DINNER IN LONDON

This year's annual autumn dinner of the Society was held in the Connaught Rooms, London, on October 13, Dr. E. F. Armstrong, F.R.S., President, in the chair. Among the guests were Mr. Roscoe Brunner, the Rev. E. C. Pearce, D.D. (Vice-Chancellor, Cambridge University); Mr. Robert Hicks (Master of the Salters' Company); Mr. Chas. T. Heycock (Prime Warden of the Goldsmiths' Company); the Hon. W. Hulme Lever; Sir R. Waley Cohen; Mr. Max Muspratt (Chairman of the Association of British Chemical Manufacturers); Dr. H. S. Hele-Shaw (President of the Institution of Mechanical Engineers); Mr. A. Chaston Chapman (President of the Institute of Chemistry); Mr. P. A. Ellis Richards (President of the Society of Public Analysts); Mr. A. Gordon Craig (Chairman of the Chemical Industry Club); Dr. T. M. Legge (Chief Medical Inspector to the Home Office); and Mr. E. G. Gillick, the designer of the Messel Memorial Medal.

Proposing the toast of "The Society of Chemical Industry," Mr. Roscoe Brunner said that although they could have selected a more distinguished person than himself to propose this toast, they could not have chosen a more appropriate one because his family and business connexions with the Society dated from its very commencement. Mr. Ludwig Mond, his father's partner, was chairman of the first meeting which started the Society, and his patron saint, Henry Roscoe, was the Society's first president. Incidentally, Henry Roscoe had had something to say about the tonnage of salt which had been decomposed during his first year of office

by the Leblanc process, and it was noteworthy that the tonnage of soda produced in that year was equalled in ten days during the palmiest days of the ammonia-soda process. That showed how the world had progressed. He ventured to say that the Society of Chemical Industry since its foundation had done more to raise the status of the chemist than any other agency. He could claim to have been connected with the chemical industry since 1874, and in those days the elder members of the Society would remember that a chemist who had not been educated somewhere on the Continent was not considered worth his salt; but we had progressed very far since then. The scientific education in this country was certainly better than the scientific education in any other country in the world. Even Oxford now had a very brilliant scientific school, and speaking in the presence of so distinguished a member of the University of Cambridge as its Vice-Chancellor, he even ventured to say that Oxford had a reputation as a school of chemistry second to none in the whole world. He hoped that the Society would continue to press for the better standing of the chemist. In his opinion it was improper that the scientific man who had studied chemistry should be classed with the pharmacist, and he hoped that the Society would take such steps as were possible to give the chemist that standing in the world to which, in the opinion of those qualified to judge, he was entitled. What steps the Society could take to that end he confessed he did not know. He wished long life and prosperity to the Society of Chemical Industry.

Dr. H. S. Hele-Shaw supported the toast and said that he felt quite at home in a gathering of chemists because of the close relationship between the work of the chemist and the engineer. He was, moreover, happy to be in the company of the sons of two men who had done so much for chemistry and engineering. The late Sir John Brunner was one of the greatest friends of all professors and a generous host. When they wanted advice, assistance, and sometimes pecuniary assistance, they knew where to go and never came away empty. Mr. Max Muspratt, who was present, was also the son of a man who had always assisted the universities. The objects of the Society of Chemical Industry and the Institution of Mechanical Engineers were identical in their respective industries, and everyone knew how the chemists and engineers had come together and were jointly responsible in aiding, backing up and making a success of the noble efforts of the fighting line during the war. It was admitted that the engineers and the chemists did not fail when the crisis came. All these things made him, as an engineer, feel at home in a gathering such as this. The chemist of to-day was not the chemist of the old days. Times had changed. The picture of the old chemist was that of a venerable man with a long beard reaching to the ground, a man who worked in a very dark and mysterious place, with, perhaps, a long tall hat, something like a fool's cap, on his head, with various retorts and furnaces all around him. That old idea of a chemist, like the old idea of an engineer, had passed away. The chemical works of to-day had its furnaces and retorts, but there was a great development of engineering appliances in the chemical works of to-day, and it was this which constituted a great bond of union between the chemist and the engineer. Engineers and chemists must co-operate,

for it was co-operation which formed the strongest bond of union between men. In another respect the Society of Chemical Industry and the Institution of Mechanical Engineers had an interest in common, and that was they both issued Journals. The ably-edited *Journal of the Society of Chemical Industry* gave the latest information of what was going on all over the world, just as the *Journal of the Institution of Mechanical Engineers* tried to do. The Institution of Mechanical Engineers had just celebrated its 75th anniversary and had a membership of 10,000. The Society of Chemical Industry was in its 40th year and had a membership of about 6000, a figure which the Institution of Mechanical Engineers reached ten years ago. He hoped that in another ten years the Society would have a membership equal to that of the Institution of Mechanical Engineers and that it would continue to progress and flourish.

The President (Dr. E. F. Armstrong), replying to the toast, said that in the old days chemistry was a very formal science; chemists were very formal people and they used to have very formal dinners and sit at long tables. Everything now had changed. Formality had gone by the board and ladies now appeared at their functions. It was, indeed, the desire of the Society that the proceedings should be as informal as possible and that enjoyment should be general. If we endeavoured to take a broad view of the present as compared with the past, it was instructive to cast our eyes right back to ancient Egypt, to ancient Greece, and to the wonderful Roman Empire, and to reflect in what way we differed from the men and women of those times. Had we progressed in Art? He thought the answer was No. Had we progressed in Literature? The answer was No. Had we progressed in Government, whether State or Imperial? Had we progressed or were our methods not founded on those of the ancient Empires? Why was this age different? Was it not because of mechanics and mechanical inventions? This was a mechanical age and all the changes which had taken place were due to the brains of man evolving mechanical aids for his well-being. The theme which he wished to elaborate for a moment was that whilst we used the term "mechanical" and thought of the mechanical inventions, was it not the chemist who had made these discoveries and the engineer had taken the credit? Ought not it to be asserted at meetings such as this that engineering was but the handmaid of chemistry, and that the engineer was but the kindly gentleman who carried out in the world the ideas which the chemist had conceived in the laboratory? What they wanted to drive home was that the engineer—who he believed originally was a Scotsman—was a very canny man. They had just been told that 35 years before the chemists, the engineers got together and formed a society, and the moral they had to learn was that the engineers got together and as a consequence of that they had got the ear of the public and the credit, and well they deserved it, because surely the prize was to the swift. Chemists did not seem to have been swift enough. Take the social services which were so essential to the public. In the case of the water supply of the great City of London, which was the outstanding name? He believed it was the name of Sir Edward Frankland. But who really got the credit for the water supply of the City of London? It was one or other of their friends

the engineers. The same thing applied to sewage; it was the chemist who had made the discoveries which had rendered it possible to live in our great cities, but it was the engineer who had reaped the reward both materially and in the shape of knighthoods and the like. There was something about the chemist which was hard to define. Chemists seemed to suffer from an excess of modesty, and if they were to reach that standard of excellence and to have that weight in the counsels of the nation they deserved, something must be done to put this state of things right, and the only advice he could give them that evening was advice based on the words of the President of the Institution of Mechanical Engineers, viz., to keep on getting together. The chemists in the Society of Chemical Industry numbered only some 5000; let them get together and become 10,000 in a very short time.

Passing to another theme, the President said that the Society was unique in that its activities were world-wide. It had Sections not only throughout the British Empire, but even firmly planted in the very heart of the United States. Two Presidents had been citizens of the United States, and he wished to emphasise the importance both to the welfare of Anglo-Saxon chemistry and also to the welfare of civilisation, that British and Americans should stand together firmly at the present juncture. If any of them had sufficient leisure to reflect upon the future of civilisation they could not help having a fear for its future at the present time. The world was upset. The East was in a ferment and in the Bolshevik Great Britain had the greatest enemy she ever had in her history. At the present time we alone stood in the breach between Bolshevism and the wreck of all that we hold dear. It was a great pity that America did not understand that fact and had not yet come to our assistance. If any of them had the advantage of going to America they would realise that what was called America was not America. America was controlled politically by the inhabitants of what was known as the Middle West, and those people lived so far from the sea that they did not understand the problems of Europe. Some of the enlightened men in America, and particularly enlightened chemists, realised the danger, but as chemists we must make our brother chemists in America alive to the fact that the situation menacing civilisation is a grave one. We must co-operate as chemists and develop an Anglo-Saxon chemistry. The first steps in that direction had already been taken, for the Society of Chemical Industry was almost a pioneer and unique in having an American Section; he felt that a message should go forth across the seas on the occasion of a meeting like this to tell our American friends that there were duties bigger than national duties, namely, a duty to civilisation. The time had come when chemists must hang together if they were to go forward, and they must put the interests of their profession before themselves. He wished to thank Mr. Roscoe Brunner and Dr. Hely-Shaw for the kind words they had said about the Society, and to express the hope that the chemists could rely upon the support of the great and successful manufacturers and their friends the engineers.

Mr. Edwin Thompson proposed "The Visitors," and in mentioning their names said the Society looked forward with very great pleasure to being

the guests of Cambridge at the next annual meeting.

The Rev. E. C. Pearce (Vice-Chancellor, Cambridge University), who replied, said that although, as Mr. Roscoe Brunner had said, Oxford University might have a school of chemistry second to none, he noticed that the Society was not going to Oxford for its next annual meeting. Speaking of the applied chemist and the pure chemist, he said that in Cambridge they had a very great respect for the applied chemist, because he had done a great deal for the University and was going to do much more for it. Some of them might know that the oil firms a little time ago gave the University 200,000 guineas because they realised what pure chemistry in Cambridge was doing for them. The University very much appreciated the action of the oil firms, and wished that other firms would do the same because they were all very poor in Cambridge. That was really no laughing matter because the salaries for which people who were worth very much more were working in Cambridge would surprise those present if he were to mention them. That, however, was rather a domestic matter; on behalf of the visitors, he wished to say that if the Society enjoyed itself in Cambridge at its next annual meeting as much as he had enjoyed himself—and he was sure the other visitors, too—at that dinner, the University would be more than repaid.

NEWS FROM THE SECTIONS

BRISTOL

On October 13 the first session of the Bristol Section—which does not now include South Wales—was inaugurated by an address from the President, Dr. E. F. Armstrong. Mr. C. J. Waterfall, the chairman of the Section, presided over an audience of 111 members and guests, the latter including a large number of students of the Chemical Department of Bristol University. Dr. J. P. Longstaff was also present. At the close of the address votes of thanks to Dr. Armstrong were moved by Prof. F. Francis, on behalf of the students, and by Dr. T. H. Butler, seconded by Dr. F. W. Rixon, on behalf of the members of the Section.

Dr. Armstrong, who chose as his subject "The Importance of the Chemist to the Nation," first spoke of the great services rendered by chemists during the war, and said that it was the duty of the Society and possibly of the Institute of Chemistry to see that such a shortage of chemical munitions which was then experienced would never occur again. The man-in-the-street did not fully realise the value of those services, and he was sure that the daily Press did not, for from time to time it made announcements of great discoveries which either were erroneous or had been made many years before. The ignorance of the public was due mainly to the ignorance of the Press, and the chemist was responsible for the latter. The chemist was far too modest and had allowed others, *e.g.*, the engineer, to take the credit that was due to him. Prof. Hinchley had said that the success of our chemical industry depended upon our progress in engineering, but he (the speaker) would say the success of our engineering industry depended upon our progress in chemistry. That was well illustrated by the history of the development of high-speed steel; the credit of the achievement had gone to the engineer. Most

applied sciences were really applied chemistry; and the chemist's work had laid many of the foundations of human progress. As illustrations might be cited the solution of problems connected with sewage disposal and other public utility services, therapeutics, the discovery and manufacture of antiseptics, food-supply, and so on. How came it that the chemist's work was unknown or imperfectly understood? In the first place, the youth of the country was brought up largely on obsolete educational methods. Almost everyone posed as an expert on education, and hence that subject had been a great battlefield for would-be reformers; and the more would-be reformers the smaller the progress. There had been some advance in the teaching of science, but the urgent need was to stimulate the pupil's interests and activities in such a way that he learnt without conscious effort things really worth knowing, and not merely such things as the names and deeds of professional cricketers and football-players! By teaching science in that way, the public would learn to appreciate it and there would be an end to the murders of elementary scientific facts committed by the Press. At present chemists were almost incomprehensible to one another; how much more so must they be to the man-in-the-street. They must learn to express themselves in clear and simple language. They had many advantages over the average man; in their first year's training in the University, experience in analytical work should inculcate the habit of inquiry and develop to some extent the critical faculty; in the second year they should acquire the synthetic, the constructive, habit of thought; and in the third year, when they passed on to theoretical studies, they had a good opportunity of developing their reasoning faculty. Chemists had something to learn from the medical profession, especially in the matter of standing together. No profession exercised so much authority with so little knowledge. How did they do it? The explanation was that every medical man praised every other medical man. On the other hand, the characteristic of the chemist was to condemn every other chemist. Chemists must learn to speak with one voice. On several occasions when he had taken part in a deputation to a Cabinet Minister on some question of importance to chemical industry, he had learned that a day or so before an equally eminent deputation of chemists had waited upon the Minister to express diametrically opposite views. Unless chemists pulled together they would never speak with one voice and never exercise any real power in national affairs. He regarded the formation of any new society as a potential disaster to the community of chemists. There should be one, and only one Society, with sectional groupings, if necessary, but all under the umbrella of a Federal Council, to which the affiliated sections would send representatives. With the exception of organised labour, the most powerful community in the country was the brewing industry, and this was because it spoke with one voice. The organisation of chemists in this country compared badly with that in America and Germany. Lately the Institute of Chemistry had opened wide its doors and was now really representative of the chemical profession; and he would ask all those who could to support what he might term the latest form of collective chemical activity, *viz.*, the Chemical Industry Club, which had the great advantage of being one of the few places where chemists could meet and converse informally.

Speaking to the younger chemists present, Dr. Armstrong pointed out the need for greater self-assertiveness on their part, particularly in regard to joining in discussions at meetings like the present one. In the past the work of leading and supporting the Sections had been left to a small minority. It would be a healthy sign if at an election for a local committee there were twice as many candidates as there were vacancies to be filled. Then, again, the elder men complained sometimes of narrowness of outlook on the part of the juniors. Personally, he thought that an attempt was made to teach far too much in the University course. This was not the fault of the teacher, but of the syllabuses on which examinations were based. The result was that far too much time was spent in preparing for examinations. The ultimate test of a "first-class" man was his ability to acquire knowledge of any subject in which he was interested. Broadness of outlook should be cultivated to the fullest extent possible in private life; and the future chemist would benefit if he would almost drop his chemistry as chemistry and regard it as a training in scientific method, which was to be applied to the broadening of his interests. When the University graduate entered the works he would find that his knowledge was more up-to-date than that of many with whom he had to work, and this advantage, among others, would give him driving power; the ability to speed up a process or any part of it was worth more than all the first-class honours in the world. The chemical profession was terribly overcrowded at the present time, and the men who entered the Universities during the post-war boom were now leaving them at a time of great industrial depression; to find employment was very difficult. These men should remember that they had lost nothing by their scientific training; if they had profited by it they would be in a position to take any job provided it was an honest one, i.e., one that required hard work and "push." Better progress could be made in commercial posts, for which there was much less competition, than in the position of junior chemist, which too often led to nowhere.

SOUTH WALES

The first meeting of this new Section was held on October 20, in the Technical College, Cardiff, Prof. C. M. Thompson presiding. A paper was read by Prof. W. J. Jones on "The Congealing Temperatures of Essential Oils," describing an investigation carried out in the University College, Cardiff, on essential oils, and in which special attention was given to their purification and to the thermometry. It was shown that European oil of rue consists of a solution of methylheptylcarbinol in methyl-nonyl ketone; the congealing temperatures of the purest product, after repeated fractional crystallisation followed by distillation *in vacuo*, was found to be 12.6° C. Aniseed oil showed a maximum congealing temperature of 21.3° C., which is also the freezing-point of pure anethole. When the oils are at least of 93 per cent. purity, it is found that the percentage of impurity is directly proportional to the difference between the observed freezing-point and that of the pure oil; so that a simple determination of the congealing temperature affords an accurate method for the analysis of essential oils when the required data on the pure oils have been obtained. Many of the required data are given in the paper.

CHEMICAL ENGINEERING GROUP

On October 20, in the Hotel Cecil, London, members of the Group gave a complimentary dinner and made a presentation to Mr. H. Talbot on the occasion of his forthcoming marriage, as an expression of appreciation and gratitude for the good work he has done as hon. secretary of the Group. Mr. J. Arthur Reavell, chairman of the group, presided and proposed Mr. Talbot's health; other speeches were made by Prof. J. W. Hinchley and Messrs. C. S. Garland, F. A. Greene, W. J. Geo, F. H. Rogers and E. A. Alliot. A programme of music, as well as a "syncopated" orchestra, contributed to the general enjoyment.

MEETINGS OF OTHER SOCIETIES

THE CERAMIC SOCIETY

The eleventh meeting of the Refractory Materials Section of the Ceramic Society, held in Birmingham on October 3 and 4, was characterised by a full and varied programme. Lt.-Col. C. W. Thomas presided, and after a few introductory remarks from him the regular business commenced with a discussion on "Bricks for Coke Ovens." This was opened by Mr. A. H. Middleton's paper, in which he strongly advocated the adoption of silica bricks in preference to the clay silica bricks now mostly used in this country. There seemed to be fairly general agreement that silica bricks would give better results in cases where salty coals were coked, but in other cases, whilst some speakers favoured the use of silica bricks, others considered that, having regard to the different conditions here and in America, a satisfactory quality of the type of brick now used would be more suitable.

Sir Arthur Duckham described "Some New Forms of Kilns" which have been successfully used during the last few years. One of these consists of 16 chambers placed in two rows side by side. Each chamber has four fireholes and bags, and the firing is semi-gaseous with down-draught. The products are firebricks, burned to cone 13, and artificial draught is recommended. A second type of kiln consists of a single chamber with a central bag, heated by an outside producer burning coal. This gives even heating and other satisfactory results. In an open tunnel-kiln, cross walls on each truck, registering with offsets on the kiln walls, force the gases to travel zigzag, and in this way the length of the tunnel-kiln can be reduced from, say, 300 ft. to 130 ft. The heating is even, and cooling is greatly facilitated. An annular tunnel-kiln was designed for burning large glazed goods. Continuity of the tunnel is broken at the unloading and loading point, but the annular firebrick tray carrying the material is continuous all round the kiln. The kiln is heated by producer gas burned in six separate horizontal flues placed one above another in the side walls of the tunnel. Mechanical draught is provided by fan and motor. The chief advantages of this kiln are convenience of working, elimination of trucks, even heating, and economy of fuel.

"The Grading of Silica Bricks" was the subject of a paper by Messrs. P. B. Robinson and W. J. Rees. The results obtained led to the conclusions that for a mechanically strong brick (a) a hard rock crushing into fragments of high angularity is

necessary; (b) the best size for the largest pieces in the brick is 6—7 mm., these large angular pieces imparting strength to the brick both at high and low temperature; (c) at least 40 per cent. of fine ground material passing 100-mesh should be used, and for a dense brick addition of fine ground material from a ball-mill must be made; and (d) the bricks must be well-burned.

In a paper on "The Behaviour of Fireclays, Bauxites, etc. on Heating," by Mr. H. S. Houldsworth and Prof. J. W. Cobb, the materials investigated included several forms of silica and alumina, red and white bauxites, kaolin, fireclays, and other hydrated compounds of silica and alumina, and the three minerals of the composition $Al_2O_3 \cdot SiO_2$. The outstanding points are:—(a) Kaolin and all the clays and shales examined show distinct heat absorption at 500° — 530° C. and heat evolution at a higher temperature; (b) this heat evolution occurs at 1060° — 1130° C. with pure alumina made by calcining aluminium nitrate at 700° C., but about 100° C. lower with the bauxites and clays; (c) most of the materials show heat absorptions below 500° C., presumably due to the loss of water from colloid substances; (d) the phenomena observed with the clays are not primarily dependent on the presence of silica, being noticeable with alumina and with a red bauxite practically free from silica; (e) although alumina calcined at 700° C. and the bauxites and clays showed marked heat evolution at about 1000° C., precipitated alumina gave no sign of it.

"Some Changes Taking Place in the (Low-Temperature) Burning of Stourbridge Fireclays" was the title of a paper by Mr. C. E. Moore. Four different clays were examined, two Old Mine and two New Mine, of which analyses are given, as well as very numerous data concerning contraction, porosity, specific gravity, hygroscopicity, solubility in HCl, heating curves, and dehydration. The chief conclusions are:—(1) Three definite critical ranges are to be found in Stourbridge fireclay at temperatures approximating to 700° C., 920° C., and 1030° C.; (2) the changes take place in all the clays of the series and at similar temperatures in each; (3) the magnitude of the changes decreases slightly with the alumina content, particularly of the changes at 700° C. and 900° C. The change at 1030° C. is probably of a purely mechanical nature.

A paper entitled "X-Radiogram of Kaolinite, and the Thermal Decomposition of Clay" was communicated by Prof. W. H. Bragg and Dr. J. W. Mellor. Prof. Bragg has recently been working on the structure of crystalline powders with the aid of X-rays. He has found definite crystalline structure in kaolinite before heating. After heating at 600° C. it becomes practically non-crystalline, showing the merest trace of crystalline material. Radiograms of china clay were found to agree with those of kaolinite.

"An Examination of Refractories by the Oxy-Hydrogen Blowpipe," by Mr. A. L. Curtis, relates to a method for rapidly examining the properties of refractories, especially in small amounts. Coal gas or acetylene may be used instead of hydrogen, but acetylene is difficult to control for a small test-piece. The refractory in powder is mixed with water or with a solution of dextrin in water. For check tests Seger-cone mixtures are similarly prepared, and the number of seconds required to produce the desired effect is noted. A camera is used

to record appearances, microscope- and telescope-objectives being employed. The effect is watched on a screen all the time.

The final paper was by Dr. C. H. Lees, "On the Stresses in Cylindrical and Spherical Bodies due to Differences of Temperature Inside and Out."

THE CHEMICAL SOCIETY

The first ordinary scientific meeting of the session 1922—1923 was held on October 5. The President, Sir James Walker, alluded to the appointment of Dr. M. O. Forster to the post of Director of the Indian Institute of Science, Bangalore, and said that his wise guidance of the Society's finances during the critical period of high expenditure had obviated further increase in the subscription. Prof. J. F. Thorpe had been appointed by the Council to fill the office of treasurer, and Prof. J. T. Hewitt to that of vice-president, each to hold office until the next annual meeting.

Sir J. Walker made a further appeal on behalf of Russian men of science, and read a letter from the president of the Russian Physical Chemical Society acknowledging assistance already given. As an example of the difficulties with which scientific men in Russia had to contend, he said that it had been ascertained that whereas the salary of a Russian professor averaged an equivalent of about £3 10s. a month, the cost of commodities which he had to purchase was approximately double their cost in this country.

The following papers were read:—(1) "Cupric tetrammine nitrite and the corrosion of copper by aqueous solutions of ammonia and of ammonium nitrate": H. Bassett and R. G. Durrant. (2) "The additive formation of four-membered rings. Part I. The synthesis and resolution of some derivatives of 1:3-diazidine": C. K. Ingold and H. A. Piggott. (3) "A determination of the relative proportions of the isomerides in nitrotoluene or toluidine": W. H. Patterson. (4) "Rates of reduction of nitro-groups by hydrogen in the presence of colloidal palladium, especially of nitrotoluene isomerides": W. H. Patterson.

(1) Prof. Bassett has examined the action of ammonium nitrate on copper in presence of air, and found a blue product, the tetrammine nitrate $Cu(NH_3)_4(NO_3)_2$, and a green one consisting mainly of the insoluble basic nitrate $Cu(NO_3)_2 \cdot 3Cu(OH)_2$. The small amount of nitrite which was found in the corrosion products results from the catalytic oxidation of ammonia and not from the reduction of nitrate, for some nitrite is always formed when air and aqueous ammonia act upon copper. Pure cupric tetrammine nitrite $Cu(NH_3)_4(NO_2)_2$ is best prepared by extraction of the basic nitrite $Cu(NO_2)_2 \cdot 3Cu(OH)_2$ with ammonia (0.880). It has not the formula $Cu(NH_3)_2(H_2O)_2(NO_2)_2$ given to it by Pélagot (Comptes. rend., 1861. 53, 209), nor does it deflagrate. At 100° C. it forms the diammine nitrite, and at a higher temperature it decomposes leaving a residue of copper oxide. Pure cupric tetrammine nitrite and nitrate are a little more sensitive to shock than picric acid; a mixture of the two is much more sensitive.

A meeting was also held on October 19, when Prof. H. E. Armstrong presided, and papers on valency and polarity in organic compounds were presented by Prof. T. M. Lowry, Dr. J. Kenner, and Mr. W. E. Garner.

SOCIETY OF LEATHER TRADES CHEMISTS

A meeting of the British Section of the Society of Leather Trades Chemists was held in the Leathersellers' Technical College, London, on October 6. Mr. J. R. Blockey presided over a good attendance.

Reports were presented from some of the Analysis Committees, and a long discussion arose on the question of the determination of Insolubles in Tannin Analysis. Mr. D. Woodroffe sent a report from the Crome Leather Analysis Committee.

The following papers were read:—(1) "The estimation of sulphides by means of standard zinc sulphate solution": W. R. Atkin. (2) "The estimation of ammonia in lime-liquors without distillation, and incidentally the simultaneous estimation of caustic alkalinity": W. R. Atkin. (3) "Proposed provisional method for the analysis of lactic acid": F. C. Thompson. (4) "Water-soluble matter in leather; its estimation and significance": J. R. Blockey. (5) "The sampling and preparation of leather for analysis": J. R. Blockey.

Discussion followed the reading of the papers, the first three of which came as contributions from the Limcyard Control Committee, and the other two from the Sole-Leather Analysis Committee.

THE PROPOSED INSTITUTE OF PAINT AND VARNISH TECHNOLOGISTS

Members of the Paint and Varnish Society and of the Oil and Colour Chemists' Association met at dinner in London on October 10, and resolved unanimously to take steps to form an Institute of Paint and Varnish Technologists. Sir Ernest Benn presided, and among others present were Prof. H. E. Armstrong, Prof. T. M. Lowry, Dr. F. Mollwo Perkin, Dr. R. S. Morrell, Dr. J. N. Friend, Dr. M. B. Blackler, Messrs. T. H. Barry, G. H. Howse, Noel Heaton, A. S. Jennings, J. Cruikshank Smith, H. D. Bradford, H. A. Carwood, W. F. Reid, W. J. Palmer, C. Harrison, and C. A. Klein.

The opinion was expressed that the formation of an Institute of Paint and Varnish Technologists would bring together two bodies which had worked independently since 1918. It was felt by those members of the Oil and Colour Chemists' Association who were present that the best interests of the industry would be served by co-operation in such an undertaking. The most important function of the Institute must be to issue a *live Journal*, which would help the members to keep abreast of modern developments in the industry. Since the failure of the National Federation of Paint and Varnish Manufacturers to devise a scheme of organised investigation, it was hoped that the proposed institute would be able to encourage research work throughout the country and, if possible, to form a centre for providing a better knowledge of the properties of the raw materials in the industry, whereby goods could be produced more economically and of a uniform standard of excellence. The Institute would also influence the education of its future members and endeavour to establish some kind of professional status for the paint and varnish industry. It would afford members an opportunity of reading papers and would help to maintain a high standard of qualification among its technical members. One of

the speakers at the dinner considered that if each of the 250 paint manufacturers in this country subscribed £10 a year, a good start would be made towards carrying out the proposals which were approved by those present at the dinner; as an insurance against ignorance it would be well worth the money.

A provisional council of nine members of the Oil and Colour Chemists' Association and nine members of the Paint and Varnish Society was elected to examine the proposed articles and memoranda of association as well as to consider the financial requirements. The report of this council will be submitted to the two societies, and if approved by them the Institute will be inaugurated. The members of the provisional council are:—Dr. J. N. Friend, Dr. R. S. Morrell, Dr. H. H. Morgan, Messrs. S. G. Clifford, E. S. Hanes, S. K. Thornley, A. de Waele, W. J. Palmer, H. A. Carwood (all of the Oil and Colour Chemists' Association); Dr. F. M. Perkin, Dr. M. B. Blackler, Messrs. Cruikshank Smith, W. F. Reid, A. S. Jennings, C. Harrison, Noel Heaton, C. A. Klein, and H. D. B. Bradford (of the Paint and Varnish Society).

INSTITUTION OF PETROLEUM TECHNOLOGISTS

The opening meeting of the current session was held on October 10 at Burlington House, W., Prof. J. S. S. Brame presiding. A paper on "Standardisation of Petroleum Tests" was read by Dr. A. E. Dunstan.

The lecturer recalled the speech of Mr. Alexander Duckham in 1917 in which he suggested that the Institution should appoint a Standardisation Committee whose function should be to investigate methods of testing and to recommend standards for adoption in this country. That suggestion received strong support from many quarters, and early this year a Standardisation Committee, with Mr. Duckham as chairman, was appointed. The range of investigation and deliberation was divided among six sub-committees, and the tentative recommendations of these sub-committees up to the present date were set forth in the paper with the object of stimulating discussion and inviting helpful criticism before the conclusions were revised and summarised by the main committee. The Standardisation Committee had worked in close accord with the British Engineering Standards Association and the American Society for Testing Materials, and in many cases the valuable recommendations of the latter society had been adopted without modification. It was intended to arrange meetings between the Committee and the various firms of instrument-makers in order to assist in the attainment of uniformity in apparatus used for petroleum-testing. Prof. Brame had consented to edit a special brochure containing the recommended tests, which would be tentative tests and subject to periodical revision, if necessary, and it was anticipated that this brochure would be published early next year.

Messrs. Alexander Duckham, Arnold Philip, Le Maistre, and Anfilogoff took part in the resulting discussion, and comments and criticism in writing were invited for consideration by the Committee and for publication in the correspondence columns of the Institution's *Journal*.

AMERICAN ELECTROCHEMICAL SOCIETY

The annual meeting of the Society was held in Montreal on September 21 and 22. Dr. C. G. Schluederberg, of Pittsburgh, Pa., president of the Society, gave an address upon "Electrochemistry and the Electrochemist," in the course of which he said: "An electrochemist is a cosmopolite in the truest sense of the term. He must be an engineer, chemist, metallurgist, manufacturer, and an all-round scientist. In order that he may keep abreast of developments he must be broadminded, progressive and aggressive." Papers were read "On Electric Heat; its generation, propagation and application to industrial processes," by E. F. Collins; "On the Principles of High Temperature Furnace Design," by E. L. Smalley; "Some Electrical Properties of Alloys at High Temperature," by M. A. Hunter and A. Jones; and on "Resistivities of some Granular Resistor Carbons," by C. E. Williams.

Of the technical papers presented on the 22nd, that by P. S. Gregory, of the Shawinigan Water and Power Co., upon "Electric Generators and their Application," was of greatest local interest. It was followed by a very good discussion, fruitful of much general information upon the subject, which is considered one of the most important in electrochemistry. The type of generator seen by the members of the Society of Chemical Industry during their visit to Shawinigan in 1921, has been further developed and improved and made more applicable to conditions in Canada by F. T. Kaelin, (*cf. J.*, 1922, 94 κ , 412 κ). By the adoption of these electric generators, and utilisation of the "off peak" hours, the two large industrial factories of the Laurentide Pulp and Paper Co. and the Belgo-Canadian Pulp and Paper Co. are saving 400 tons of coal daily. In the ensuing discussion, Prof. W. D. Bancroft declared that some day the electric firing of porcelain would bring artistic and decorative porcelain to a very much higher state of perfection than was formerly thought possible.

SAFEGUARDING OF INDUSTRIES ACT

GALLIC ACID

On September 26 Mr. Cyril Atkinson, the Official Referee, heard the complaint made by Mr. J. L. Rose, chemical manufacturer, of Barking, that the Board of Trade had improperly removed gallic acid from the list of chemicals subject to import duty under Part I of the Act. The parties were not represented by counsel, and the hearing was terminated within three hours. Mr. W. J. U. Woolcock, M.P., General Manager of the Association of British Chemical Manufacturers ("A.B.C.M."), appeared for Mr. Rose, who is a member of the Association, but the Referee stated that in future he would enforce the rule that a complainant must either conduct his own case or be represented by a barrister or solicitor.

Mr. Rose, after giving evidence in camera concerning his process of manufacturing gallic acid (3,4,5-trihydroxybenzoic acid), said that he had been making it since the beginning of the war; for 30 to 40 years prior to that time all the gallic acid used in this country had been imported from Germany.

The imported acid was sold by merchants; he had supplied the acid to R. W. Greef and Co., and had dealt only with that firm's fine-chemical department; but he was unable to bring into court such trade witnesses because merchants as a class were opposed to the Act. Gallic acid was regarded by the trade as a fine chemical. In his process of manufacture samples had to be taken and tested at every stage; he employed a staff of fifteen of whom two were qualified chemists. The gallic acid he manufactured was of about 98 per cent. purity.

Mr. Woolcock said that gallic acid was made only from gall-nuts in plant similar to that used in making azo-dyes and other fine chemicals; the nature and amount of supervision required justified the classification of the substance as a fine chemical. In previous inquiries the heading to Group VI in the classification of the A.B.C.M. had been wrongly interpreted. The first term—"fine chemicals"—alone was definitive, the remaining terms ("analytical," "pharmaceutical," etc.) were illustrative: a chemical might well be a fine chemical even if it did not come under one of these descriptive sub-headings. Gallic acid was not covered by any one of the sub-headings, but the same was true of many other fine chemicals. On the other hand, he suggested that the group to which the Council of the Association allocated a member was a criterion; a member could not join any group he liked. Mr. Rose was a member of Group VI. Gallic acid was used in the manufacture of pyrogallie acid, an admittedly fine chemical, and of certain dyes, which were but fine chemicals coloured. When the Schedule to the Dyestuffs Act was being drawn up, the Board of Trade had omitted gallic acid from it on the ground that it was not a dye-intermediate; it was undoubtedly the intention of the legislature to include gallic acid within one Act or the other.

Mr. J. Ronea, for the Board of Trade, accepted substantially all that had been said. In compiling the list of dutiable articles, the Board had considered the trade classification of "heavy" and "fine," and it had not applied to each article what might be called the secondary tests of its correct classification. In doubtful cases, however, it was useless to refer to the trade, different sections of which would invariably hold divergent opinions, and certain secondary tests had to be applied. Originally the Board had never thought of applying the secondary tests to gallic acid, having no doubt that it was a fine chemical, but after its inclusion in the Schedule had been challenged, thus proving that in fact there was doubt as to its correct classification, the Board gave consideration to certain criteria or secondary tests as laid down or described by the Referee in the Tartaric Acid case (*cf. J.*, 1922, 116—118 κ). For example, in his judgment in that case the Referee stated that, the search for a definition of fine chemical having failed, he would adopt trade usage as the test and "the trade regarded heavy chemicals as commercial products mainly used for industrial purposes." By that test gallic acid was not a fine chemical, and it was consequently deleted from the original list.

Mr. Woolcock said that if the Board's interpretation of the judgment were correct, very many admittedly fine chemicals, including all those used in making other fine chemicals, would have to be removed from the list. The Referee said that he had not intended his remarks in the judgment

mentioned to constitute a definition; he still believed that, in the main, the trade regarded a big industrial use as a criterion of a heavy chemical. Mr. Ronca said that the Board did not accept the view that industrial chemicals were invariably used in large quantities; some were used in very small quantities. The Referee pointed out that Mr. C. A. Hill's paper on the manufacture of fine chemicals, read before the Society of Chemical Industry in 1916, was definite and important evidence for complainant's view, but he required direct evidence, dating from before the passing of the Act, that the trade regarded gallic acid as a fine chemical. After the adjournment for lunch, Mr. Woolcock produced the new trade catalogue "Where to Buy" in which gallic acid was listed as a fine chemical. Mr. C. A. Hill stated that for 25 years at least he had known gallic acid as a fine chemical and had never heard it referred to as a heavy chemical; and copies of the *Journal of the Society of Chemical Industry*, dating from 1895, were produced to show that up to 1909 gallic acid had been classified in the *Abstracts* among fine chemicals. The Referee stated that he was satisfied with the evidence produced, and no evidence had been given to the contrary. Mr. Ronca's view was that his original classification was right. In future he would regard trade usage as determinative if it can be found, and evidence must always be given on that point.

Judgment was issued on October 18, as follows:—

The complaint in this case is that gallic acid has been improperly excluded by the Board of Trade from the lists of articles dutiable under the Act. Gallic acid was originally included in the list. Complaint was made of this inclusion, and the Board of Trade took it out of the list in the belief that it was covered by something I said in the Tartaric Acid case. There was not any real contest at the hearing before me. None of those persons who might be interested in maintaining the exclusion of the substance from the list attended to take part in it. I am satisfied that the usual notices have been given and that persons interested have had the usual opportunities of giving evidence and of taking part in the argument. I regret that no one of them has availed himself of these.

On the evidence of Mr. Hill and Mr. Rose, and of the chemical journals and catalogues that were put in, I find that gallic acid has been and is regarded by the trade as a fine chemical. I think, therefore, that the original inclusion of the substance in the list was right and that its present exclusion is wrong. The reason for this exclusion is the supposition that in the Tartaric Acid case I defined a heavy chemical as a commercial product mainly used for industrial purposes. It is said that as gallic acid is a commercial product almost entirely used for industrial purposes therefore it is a heavy chemical. So far from laying down any definition in the Tartaric Acid case of the terms "heavy" and "fine," I expressly decided that there was no scientific or trade definition of the terms and that therefore the test was the trade classification in each particular case. The view that I intended to express in the Tartaric Acid case was this; there was no definition of "heavy" or "fine," but that in ascertaining how any particular substance had been regarded by the trade

one would probably find that the purpose to which the substance had been put had had a good deal to do with its classification, and that for the most part chemicals mainly used, and used to a substantial extent, in industry had been classified as "heavy." I do not think that this applies to photographic chemicals. As to gallic acid, the total quantity used in a year is comparatively small, and I find on the evidence that the trade has regarded it as a fine chemical. Applying, therefore, the same test as that applied in the Tartaric Acid case I come to the conclusion that gallic acid should be included in the list and I so award. No costs.

CHEMICAL INDUSTRY CLUB

The report of the Executive Committee for the year ended August 31, 1922, shows that the Club has well maintained its position: the membership has increased from 690 to 707 and the financial position is excellent. A feature of the past year has been the strengthening of the *liaison* between the Club and the Federal Council for Pure and Applied Chemistry. For some time past three members of the Federal Council have been co-opted on the Executive Committee of the Club, and the hon. secretary of the latter has served on the Federal Council. Sir William Pope, Dr. C. A. Keane, and Mr. E. V. Evans were the original representatives of the Federal Council, but Dr. Keane, to everyone's regret, has been obliged to retire from this and other similar positions owing to illness. Dr. S. Miall has been appointed in his place. During the past year co-operation has been extended by the institution of informal, periodical meetings of an advisory body consisting of seven members of the Council and seven members of the Club. The ordinary monthly meetings were continued as usual and were much appreciated by those who attended them. The report also refers to the re-decoration of the Club premises, the provision of additional papers and magazines in the reading room, the foreign guests who were offered temporary membership, joint meetings with the Institution of Mechanical Engineers and the London Section of the Society of Chemical Industry, and to the annual dinner. This year's annual dinner will be held in the Connaught Rooms on Friday, November 24, and the speakers will include Lord Riddell and Mr. Roscoe Brunner (tickets, 15s. each, exclusive of wines). The report of the hon. treasurer is equally satisfactory. In spite of increased expenditure, there is a balance in hand of £86, in addition to a reserve fund of £100, a portion of which is being utilised to defray the cost of re-decoration.

The above reports were presented to and adopted by the annual general meeting, which was held in the Club on October 15, Mr. A. G. Craig, chairman of the Executive Committee, presiding over a good attendance. Except for some discussion upon a few points concerning organisation the business was formal. The hon. secretary, Mr. H. Edwin Coley, and the hon. treasurer, Capt. C. J. Goodwin, were re-elected, and the ballot for candidates to fill the five vacancies on the Executive Committee resulted in the election of Dr. E. F. Armstrong, Mr. A. J. Chapman, Mr. W. Cullen, Mr. C. S. Garland and Mr. T. Miller-Jones.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The continued instability of the international situation has affected the chemical market, which is very sensitive to such political disturbances; buyers have not been inclined to purchase forward, and business has been generally dull. German competition is not serious at present owing to the wide fluctuations in the value of the mark, but Belgium, benefiting from an appreciable decrease in costs, is undercutting French producers and gradually obtaining a hold on French markets. Manufacturers are again complaining of the State monopoly of the sale of alcohol. Whereas the State pays only 70 fr. and 90 fr. per hectolitre for alcohol of 95° and 99·5°, respectively, produced from beet molasses, the sale price to manufacturers of organic chemicals is so high that they find difficulty in reducing their costs so as to meet foreign competition. Fertilisers are not much in demand, and ammonium sulphate is being replaced by sodium nitrate, which is cheaper. The sugar-beet crop is very promising; the fine, rather cold weather has helped to ripen the beet, and extraction will probably be easy, as the quality is reported to be high. The estimated yield is 500,000 metric tons of refined sugar, to which must be added about 90,000 t. of raw sugar from the colonies.

An account of the International Congress on Liquid Fuels appears elsewhere in this issue. At the close of the Congress the delegates visited the petroleum field at Pechelbronn, where one well is producing at the rate of 1100 gallons per 24 hrs., and another, with an intermittent production, is yielding 45 metric tons per day. A new well is being sunk at the rate of 2 metres per day of 16 hrs. The annual output of crude petroleum in this locality is now about 70,000 t., which represents 8 per cent. of the entire consumption in France.

Metallurgy.—The general outlook is good, and the exportation of metallurgical products to Germany is increasing steadily. On September 1 the number of blast-furnaces alight was 98, compared with 94 on August 1, three having been blown-in in Alsace-Lorraine and one in the eastern metallurgical area. During the first eight months of 1922 the total output of pig iron was 3,136,482 t. and of steel 2,809,703 t. Rumours of an agreement between French and German metallurgical interests still persist, and in certain well-informed quarters are considered likely to prove true.

GERMANY

Chemical Industry in September, 1922

According to information transmitted by H.M. Commercial Secretary in Berlin, the inland demand for dyestuffs during September was satisfactory, despite a crisis in the textile industry. In many cases the orders in hand would suffice to ensure employment for some time to come, but the disparity between the amount of working capital available and the high prices of the necessary foreign raw materials compels restriction of work. The practice of investing in foreign currency may offer a security against fluctuations in exchange, but it also results in the raising of inland prices to prohibitive levels. Foreign sales were also satisfactory. A reaction in

the unusual business activity is feared owing to the increasing difficulty of purchasing raw materials from abroad. Soda and benzol have, in particular, had to be imported in large quantities. The supply of rocksalt and lime was frequently insufficient owing to the scarcity of railway trucks, and that of fuel was quite inadequate. Large quantities of foreign coal and coke had to be imported for the nitrogen and dyestuffs industries, and the use of different kinds of fuel greatly hindered operations. The paper industry has suffered severely from difficulties in procuring raw material and a crisis is anticipated owing to the scarcity of capital. Dependence upon foreign coal and raw material is also handicapping the fine ceramic industry whose output is now about 75 per cent. of the pre-war total and whose exports are but 30 per cent. of the production, or less than one-half of the pre-war figure. —(Official.)

The Potash Industry

Preliminary returns from the German potash mines show that the production during the first six months of 1922 was 5,893,711 metric tons of potassium salts, equivalent to 682,787·5 t. of pure potash (K_2O). Export deliveries were below expectation but inland sales of potash products were fairly brisk and 58 per cent. higher than during the corresponding period of 1921. The number of workers employed increased from 39,594 to 42,139, and full-time was worked until towards the end of June when 76 of the 206 works ceased production. Later advices state that export sales have improved and for the year will probably amount to 23 per cent. of the total sales (5 per cent. in 1921), and these will probably create a record, even over pre-war totals.

The Cause of the Oppau Explosion

Before the Parliamentary Committee appointed to investigate the cause of the explosion at Oppau (*cf.* J., 1921, 381 n, 453 n), Prof. Wöhler reported on the evidence of the experts who were charged with the task of finding answers to the following questions:—

(1) Is there any evidence of a criminal act? (2) Was an exceptionally powerful explosive used, and could it have been the cause of the explosion? (3) Could the use of a large amount of the explosive normally employed have caused the explosion? (4) Can a normal fertiliser-salt be exploded with the explosive used? (5) Can a salt of abnormal composition be exploded? (6) Could such an abnormal salt have been present? (7) Can a positive answer be given as to the origin of the explosion? (8) Does the fact that two successive explosions occurred indicate the possibility of another cause, and can that fact be harmonised with the suggested explanation?

The replies of the experts to these questions were negative in nearly every case, including that to question (7). A charge of negligence against the Badische Anilin- und Soda-Fabrik could not be sustained, and even when every possibility was taken into consideration, such an explosion as occurred could not have been foreseen. The experts recommend that blasting of fertiliser salts containing nitrate be forbidden (as it has been since), but do not see any necessity for discontinuing the manufacture. As the printed evidence of the experts was not in the hands of the members of the Committee, it was decided to postpone the final decision.—(*Chem.-Z.*, Oct. 5, 1922.)

Technical Utilisation of German Lignites

Prior to the war difficulties of sale restricted the output of German lignites (brown coals), and the maximum possible output was not attained despite a rapid increase in demand, which extended into the period of the war, and except for a temporary set back in 1919, has continued since. Supplies in 1921 amounted to 141 per cent. of those in 1918. In 1921-22, according to returns of the Deutsche Braunkohlen-Industrie Verein, more than 80 per cent. of the output of lignites was obtained by open-working, a factor influencing the output of this commodity, as all the coal in the country has to be mined. Owing to increased production and reduction of working hours, the number of workers engaged was about 125 per cent. greater in 1921 than in 1918.

The calorific value of lignite is only about one-third of that of coal, but the calorific value of brown-coal briquettes is about double that of the original lignite. Even then, freight charges for transport over any considerable distance, operate against the use of lignite in place of coal. The unsuitability of lignite as a fuel in certain branches of industry is also an adverse factor, and thus it comes about that lignites are exclusively employed in the districts where they are produced. In 1921, 57 per cent. of the output of lignites was briquetted, and the output of briquettes amounted to 28,243,000 tons, an increase of 116.4 per cent. compared with 1920, and of 128.5 per cent. compared with 1913. Although, owing to the lack of coal, lignites have of recent years found extended application in certain directions by the introduction of new devices, coal has not been displaced to any great extent for technical purposes. Thus the attempt to use lignites for the firing of locomotive boilers proved unsuccessful. Aided by the increased charges for transport, the "migration of industry towards coal," which set in before the war, has made considerable progress.

The following table shows the distribution of the consumption of lignite during the period January—April, 1922:—

	Lignite (crude)	Lignite Briquettes
Domestic and small industrial uses	5.1	52.7
Marine and military	—	0.2
Rail and water transport	0.3	1.0
Water- and gas-works	0.5	0.5
Electricity works	22.7	4.2
Chemical industry	22.4	5.8
Stone, earth, glass and porcelain	0.6	7.6
Textile and paper industries	13.3	6.5
Iron and metal industries	11.5	11.6
Foodstuffs	5.7	3.6
Potash and salt works	6.4	1.4
Other industries	5.5	4.9

The power station at Zschornowitz uses 7200 tons of lignite per day. It supplies Berlin with current and is also connected with the large nitrogen factories of middle Germany, and other chemical works. These works themselves are large users of lignites, and those situated in the vicinity of lignite deposits are in many cases part-owners of the mines. In this manner is explained the fact that in 1921—1922, over 15 per cent. of the output of lignite in the Mid-German district was credited to "associated factories."

In former years a considerable amount of lignite was imported from Bohemia. This was of higher calorific value and readily accessible. Gradually this trade has been abandoned in favour of the home product, and more especially of briquettes manufactured in Germany, and the imports, which

amounted to 7,960,000 tons in 1900, fell to 1,910,000 tons in 1919, rising again to 2,662,000 tons in 1921. The principal buyers are the glass, porcelain and textile manufacturers of Saxony and Bavaria.

About 1.74 per cent. of the output of lignites is used, not as fuel, but as raw material in chemical industry. Certain varieties are suitable for treatment by the Schwel process of producing paraffin and lubricating oils, and more recently for making soap. The residue, known as "Grudekoks," is a popular fuel. The production of ozokerite and liquid fuels from lignites has recently been extending.

"Rhenania" Phosphate

By the production of this material it is claimed that the problem of making a high-grade fertiliser from low-grade phosphate, without the use of sulphuric acid, has been solved. The process consists in heating to 1200°—1300° C. an intimate mixture of crude phosphate, limestone, and alkali silicate, such as felspar, phonolith or leucite, and the product is a brown mass, which is finely ground before marketing. The composition of the fertiliser may be represented approximately by the formula

$[CaO]_2 \begin{matrix} K \\ Na \end{matrix} > O.P_2O_5$, and its percentage composition

varies as follows:— P_2O_5 15—25, $K_2O + Na_2O$ 8—15 (of which $K_2O=8$), SiO_2 10—20, CaO 35—40. The phosphoric-acid content is but slightly soluble in water, but from 80 to over 90 per cent. dissolves in citric acid or alkaline ammonium citrate, and 75 per cent. is soluble in an aqueous solution of carbon dioxide.

Rhenania phosphate can be used on any type of soil, and, being strongly basic, obviates the use of lime. Over superphosphate it has the great advantages that sulphuric acid is not required in its manufacture and that the poorest grades of mineral phosphate can be utilised. Factories at Wolfersberg a. d. Lahn and Amberg (Bavaria) are producing it, and nearly one million tons has already been sold. The evidence of pot experiments and field trials is favourable.—(*Z. angew. Chem.*, Oct. 3, 1922.)

The German Commission on Atomic Weights

A second detailed report on the determinations of atomic weights published during the period 1916 to 1920 has been issued by the German Commission on Atomic Weights, consisting of Professors Hönigschmid, Bodenstein, Hahn, and R. J. Meyer. The general principles followed in drawing up the tables are described, and then the atomic-weight determinations carried out (a) by physico-chemical methods, e.g., vapour density, and (b) by gravimetric methods. Regret is expressed at the multiplication of national tables of atomic weights, as there are now Spanish, Swiss and German tables in addition to the International Table.—(*Chem.-Z.*, Sept. 7, 1922.)

The Porcelain Industry

The Union of German Porcelain Factories (Verband Deutscher Porzellanfabriken) reports that the 97 plants comprised in the Union produced 62,925 tons of porcelainware in 1921 as compared with 48,151 tons from 92 plants in 1920. Shortage of coal kept the production below capacity and wood fuel had to be used because the industry only received 49 per cent. of the pit coal, 42 per cent. of the lignite and 80 per cent. of the briquettes

required. In 1921, 13,929 men and 13,329 women workers were employed by the industry, in addition to 2090 men and 279 women employed in the offices. Production costs increased by over 200 per cent. between April, 1920, and January, 1922. Before the war the United States was the principal market for German porcelain goods. The percentage of the total exports taken by the United States was 41.9 in 1912, 4 in 1919, 12.77 in 1920, and 41.48 in 1921. In normal times about 60 per cent. of the German production is exported; in 1920 it was only 28 per cent. Japan is now Germany's chief competitor in this industry.—(*U.S. Com. Rep.*, July 10, 1922.)

UNITED STATES

The Camphor Industry

According to Dr. Stockberger, physiologist to the U.S. Department of Agriculture, the cultivation of the camphor tree and the extraction of camphor in the United States have ceased. Apparently the industry has been abandoned because of the ravages of the camphor "thrips," a pest for which no effective means of control has been discovered, and of inability to compete with synthetic camphor. The prospects were deemed not sufficiently hopeful to justify the costs incurred in waiting seven or eight years for the first harvest. Although large areas were planted to camphor in Florida (*cf.* J., 1921, 236 R, 388 R), and the various stages from planting to distillation were studied, no reliable data concerning yields or costs were obtained.—(*Oil, Paint and Drug Rep.*, Oct. 2, 1922.)

Mica in 1920

During 1920 the sales of mica in the United States amounted to 6565 short tons (842 t. of sheet and 5723 t. of scrap), valued at \$713,898 at or near the mine, representing an increase of 76 per cent. in quantity and 188 per cent. in value compared with 1919. In order of importance the chief producing States were North Carolina, New Hampshire, Virginia, Alabama, Georgia, Texas, South Dakota, New Mexico, Idaho, and Colorado. Prices were high during the first half of the year, but declined afterwards, owing to foreign competition; the average price per ton of scrap mica increased by \$11 to the record value of \$29, but the average price per lb. of sheet mica only rose from \$0.31 to \$0.32. Exports of mica were valued at \$316,169 (\$109,348 in 1919), over 75 per cent. going to England, Canada, Belgium, Japan, Cuba, Newfoundland and Labrador, in the order named. Imports of sheet mica were valued at \$3,189,377, the highest value recorded, and included 649 t. of unmanufactured mica valued at \$1,177,943.—(*U.S. Geol. Surv.*, Apr. 12, 1922.)

JAPAN

The Artificial-Silk Industry

Owing to lack of technical experience and supervision and high costs of production, the Japanese artificial-silk manufacturers cannot compete with America and Europe, and they have suspended production pending the conclusion of an agreement for co-operation with German manufacturers. In contrast with the rapid extension of the manufacture of artificial silk in England and the United States, the Japanese industry, although it

is twenty years old, has been on the verge of collapse for some time. The chief companies (Nippon Jinsokunite Seizokaisha, Toyo Jinsokunite Seizokaisha, Asahi Jinsokunite Seizokaisha, Teikoku Jinsokunite Seizokaisha and Tokyo Jinsokunite Seizokaisha) were almost unanimous in taking the above decision, but they have not yet completely closed down. Methods of improving the industry are being considered; the Asahi Co. has bought a German factory and will begin to produce in the autumn; and other companies have engaged German experts and will buy directly from Germany.—(*Chem. Ind.*, Sept. 25, 1922.)

CANADA

Industrial Notes

Two British brewing firms have recently inspected sites in the Province of Quebec with a view to establishing plants, because of their inability to meet the demand for their products on account of the import tax.

This season the sugar-beet crop of Ontario has been light, owing to the shortage of rain, and as a result only the Wallaceburg and Chatham refineries of the Dominion Sugar Co. will be operated, the plant at Kitchener being closed.

The Dominion Glass Company, which operates two plants in Montreal, proposes to erect one large plant in the vicinity of Montreal, at a cost approximating \$1,000,000, which will take over the business handled by the two present plants, and at the same time provide for expansion.

The firm of F. X. Baumert and Co., Inc., of Antwerp, has concluded negotiations for the erection of a large milk plant at Huntington, Que. This town is the centre of a large dairy industry, which is capable of delivering 2 million lb. of milk within a radius of six miles. Much of the milk went to the United States, but the new U.S. tariff has practically closed this market.

The United Kingdom was a better customer of Canada than the United States during the twelve months ending with July, according to a statement of the Dominion Bureau of Statistics. The total exports of Canadian products to the United States for that period were valued at \$304,000,000, and to Great Britain and Ireland nearly \$307,000,000. Under the new U.S. tariff, which came into force on September 23, it is expected that the export trade to that country will further decline. On the other hand, it is anticipated that there will be an appreciable development of Canadian trade with Europe and other continents.

The American Nitrogen Products Co., at Lake Buntzen, B.C., which is manufacturing nitrates from atmospheric nitrogen by the electric method, has approached the provincial government for a loan, under the Industries Act, to assist in the development of new products. The plant at Lake Buntzen has been producing nitrate of soda, which was largely exported to the United States, but the new tariff has placed such a prohibitory duty on the product that the company now proposes to manufacture nitric acid. The plant is stated to have cost \$500,000, and was operating at a good profit. C. F. Graf, of Seattle, Wash., is head of the organisation.

It is claimed that the money spent to-day in Canada on rubber products is greater, *per capita*, than in any other country in the world. In 1910 the number of rubber companies did not exceed a half-dozen, with an invested capital of \$8,000,000.

and 5000 workers. The crude rubber imported was 1070 long tons and the value of the products \$5,000,000. A decade later the rubber companies exceeded a score, operating 32 factories with an invested capital of \$50,000,000 and a personnel of 15,000. The import of crude rubber is almost nine-fold; the value of the products is approximately \$56,000,000; and the export trade amounts to \$15,500,000, which is more than treble the value of the whole output of 1910.

Petroleum

In boring a deep well for water near Vauxhall, about 28 miles north-east of Taber, Alberta, gas was struck at a depth of 840 feet. The gas flow exceeds two million cb. ft.

The Imperial Oil Co., Ltd., is to construct an oil refinery in south-east Calgary, Alberta, at a cost of \$2,500,000. The company has secured 108 acres of land and will employ between 300 and 500 men.

The report that the "Discovery" well of the Imperial Oil Co., at Fort Norman, was flowing at the rate of 70 barrels per diem has been confirmed. The flow comes from a depth of about 1000—1100 feet.

GENERAL

Proposed Honour to Prof. H. B. Dixon

A committee of past and present students of the Chemical Department of Manchester University has been formed to honour Prof. H. B. Dixon on his retirement from 35 years' service as Director of that Department. It is proposed to hold a dinner in the Midland Hotel, Manchester, on Friday, December 8, at which Prof. Dixon will be the guest of the evening, and to invite subscriptions (a) to raise a fund, to be handed over to the University authorities, from which the income will be given as grants-in-aid to necessitous students of chemistry; and (b) to purchase a medallion portraying the head of Prof. Dixon, to be placed in the Chemical Theatre adjacent to the medallions of Frankland and Roscoe. Dr. J. E. Myers is hon. secretary, and Dr. Norman Smith hon. treasurer to the committee. Applications for dinner tickets (12s. 6d), and donations to the Harold Baily Dixon Fund, should be sent to Dr. Smith at The University, Manchester.

Vanadium

A small but valuable brochure on "Vanadium, 1913—1919" (pp. 19, price 6d.) has been issued by the Imperial Mineral Resources Bureau which contains considerably more recent information than is indicated by the title. As a source of supply of vanadium, Peru has recently ousted the United States from the first place, as the following table shows:—

Output of Vanadium (in terms of Metal) contained in the Ores produced

	Peru	U.S.A. Long tons	Total
1913	—	386	386
1914	4	404	408
1915	790	560	1,350
1916	760	411	1,171
1917	895	432	1,237
1918	229	246	475
1919	491	254	745
1920	1,095	455	1,550

The large deposits of patronite, a black carbonaceous mineral containing vanadium sulphide, which occur at Minasraga, near Cerro de Pasco, Peru, and

are owned by the Vanadium Corporation of America, are estimated to contain ore in sight equivalent to 16,500 tons of metallic vanadium. The grade of ore now worked has recently fallen from 40—45 per cent. V_2O_5 in the calcined product to 30.4 per cent. (1919), and on this account the company has decided to erect an electric smelting plant to produce a concentrate containing 85—90 per cent. of the oxide. In addition to these deposits, there are extensive occurrences of vanadiferous asphalt to the south of Cerro de Pasco, in Yauli and other districts, but it is improbable that these will prove of commercial significance, except under abnormal conditions.

The chief deposits of vanadium ores, mainly carnotite, in the United States are found in south-eastern Utah and north-western Colorado. Production has declined, and in 1921 the only vanadium produced from native ores was that obtained as a by-product from carnotite worked for its radium-content. Exports of ferro-vanadium from domestic ores, of which a large proportion is shipped to the United Kingdom, amounted to 280 long tons in 1914, 1167 t. in 1917, 28 t. in 1918, 173 t. in 1919, and 100 t. in 1920 (the last three years are calendar years).

Mr. J. L. F. Vogel contributes some interesting notes on the metallurgy and uses of vanadium. The manufacture of steel claims practically the entire consumption. For steel subject to vibration, a content of 0.2 to 1.5 per cent. vanadium imparts greater resistance to fatigue or failure through recrystallisation, and the presence of 0.5 to 2 per cent., together with tungsten and chromium, greatly improves the efficiency and cutting-power of high-speed steel. Its addition to molten steel also removes nitrogen and reduces dissolved oxides.

British Chemical Plant Manufacturers' Association

The second annual report of this Association states that notwithstanding the recent critical state of trade, the Association has increased in strength and has established itself as representative of the industry it was designed to foster. The membership has increased from 23 to 33 firms. Mr. J. H. Rawson (The Widnes Foundry Co., Ltd.) has acted as chairman of committee and Mr. L. M. G. Fraser (W. J. Fraser and Co., Ltd.) as vice-chairman. Of the work undertaken during the year, mention is made of the standardisation of jacketed pans and cast-iron filter presses (*cf.* J., 1922, 52 n, 210 n). Investigations into the use of nickel for chemical plant have led to the conclusion that this metal is satisfactory for use in the construction of small vessels. A Directory of members has been issued, and the question of transport has been considered.

The Polish Iron Industry, 1922

The ore supply for the Polish and Upper Silesian iron industry has recently been the subject of a conference in Warsaw. The Poles wish to induce the ironmasters, especially those in that part of Upper Silesia which now belongs to Poland, to develop the exploitation of ores found in the country, in order not only to further the mining industry, but also to save losses on exchange. But the Upper Silesian smelters have estimated their needs at 400,000 tons per annum, whereas at present the Polish mines cannot supply more than 200,000 tons. The supply of Russian high-grade ores is practically cut off, and the Russian railways are

incapable of handling large quantities of material. The coke supply is another difficulty. Supplies are obtainable from England, Czechoslovakia, and the Waldenburg district in Germany; those from the first two countries are plentiful, but prices are very high.

Mica Deposits in Austria

According to information published in the *Berliner Tageblatt*, the mica present in extensive deposits in Styria and Carinthia is well suited for electrotechnical use. Mica from Styria has already been used industrially, and a company has been extracting Carinthian mica for some time. The Köflach fields are to be exploited by a new company, the Oesterreichische Glimmerwerk G.m.b.H., of Gratz, which will also work part of the Carinthian deposits. As there are no deposits of mica in Germany, the Austrian product should find a ready sale there.—(*Ch. of Comm. J.*, Aug. 4, 1921.)

The Fertiliser Industry in the Ukraine

The reports for June announced that all except one of the Ukrainian factories constituting the ring called "Phosphatuk" were at work, but only 1920 long tons of superphosphate was produced, as against 480 t. in May. The output of sulphuric acid was about 450 t.; of hydrochloric acid, about 32 t.; English red (colcothar) 50 t.; Glauber's salt 2.5 t.; "hypo" 2.8 t. Adequate supplies of pyrites, phosphates and fuels, particularly peat, are on hand, but none of the factories has adequate working capital.

The Russian Platinum Industry in 1922

The dredging operations in the Russian platinum regions have had to be restricted owing to the difficulty found by Russian factories in executing repairs; the number of plants now at work is only about sixteen, i.e., half the usual number. At the end of 1921 a trust—the Ural Platjina—was formed which included the six important gold and platinum mining districts, and also the platinum refineries at Ekaterinburg and Moscow. Production in the first six months of 1922 was 64.4 per cent. of that intended; the actual weight is not given, but it is stated that 46 pounds of platinum changed hands during the period from the end of April to the middle of July. It is probable that the production of the trust is small, and that considerable quantities of platinum are in the hands of the population.

Mineral Production in Russia

According to reports abstracted from the Bolshevik Press by the U.S. Department of Commerce, 97 mining plants are registered in Russia as being in working order. During the first half of 1921, 89 plants employing 15,000 men were operated, the number falling to 42 plants and 5682 men at January 1, 1922. The output of the chief ores during 1921 and the first quarter of 1922 was as follows:—

	1921	Jan.-Mar. 1922
Ores:—	Long tons	
Iron	133,831	43,013
Manganese ..	11,054	13,703
Copper	4,369	—
Chrome	3,512	97
Lead and zinc ..	4,063	2,099
Magnesite ..	9,937	4,323
Asbestos	6,083	1,032
Pyrites	2,593	—

The quantity of manganese ore dispatched from the mines during 1921 was 18,992 tons and during the first quarter of 1922, 5117 tons.—(*U.S. Com. Rep.*, June 26, 1922.)

PERSONALIA

Prof. Arthur Smithells will shortly retire from the chair of chemistry in the University of Leeds, after 37 years' service.

Dr. Percy Longmuir, of Sheffield, has been appointed Director of Research to the British Cast-Iron Research Association.

Prof. G. Errera, professor of general chemistry in the University of Padua, has been elected director of the School of Pharmacy in the same University.

Dr. W. Rosenhain, Head of the Metallurgy Department of the National Physical Laboratory, will deliver the next May Lecture of the Institute of Metals.

Dr. George Senter, Principal of the Birkbeck College, London, has been elected by the science graduates of London University to fill a vacancy on the Senate.

Col. F. M. Gaudet, C.M.G., who during the past year has been Technical Executive Officer of the Research Council of Canada, has resigned and joined a large industrial firm in Montreal.

Mr. C. S. Garland, managing director of Lighting Trades, Ltd., a vice-president of this Society, has been adopted as the Conservative and Unionist candidate for South Islington (London), in place of Sir Charles Higham.

The following appointments have been made in the Massachusetts Institute of Technology:—Dr. G. B. Waterhouse to be professor of metallurgy; Mr. W. S. Hutchinson to the chair of mining; and Dr. F. G. Keyes, formerly chief engineer to the Cooper-Hewitt Co., to be acting head of the department of chemistry.

Following the resignations of Sir H. V. Kilvert, Mr. G. W. Currie, and Dr. M. O. Forster from the Advisory Licensing Committee appointed under the Dyestuffs (Import Regulation) Act of 1920, Sir Thomas Robinson, M.P., has been appointed chairman, and Mr. R. Waddington, M.P., and Prof. G. T. Morgan members of the Committee.

The Council of the Institution of Mining and Metallurgy has awarded the Gold Medal of the Institution to Sir Alfred Keogh on the occasion of his retirement from the Rectorship of the Imperial College of Science and Technology, and the Medal of the Institution to Sir George Beilby in recognition of his contributions to science, with special reference to his researches on fuel.

Dr. Max Bodenstein, professor of chemistry in the Technical Hochschule at Hannover, has been called to the chair of physical chemistry in the University of Berlin, in succession to Prof. W. Nernst. Professors B. Helferich and A. Sieverts have been appointed to professorships in the University of Frankfurt, the latter succeeding Prof. E. Ebler in the chair of physical chemistry. Dr. F. Straus has been appointed professor of chemistry in the Technical Hochschule at Breslau.

* * *

E. Stassano, the inventor of the electric steel furnace named after him, died in poverty on May 1, aged 63 years.

Mr. Frank Washburn, who was president of the American Cyanamid Company from its inception until a short time ago, died on October 9.

Prof. F. D. Brown, emeritus professor of chemistry and physics in Auckland University College, died at Remuera, New Zealand, on August 2, aged 71.

Mr. James Lund, Vice-President of the Merrimac Chemical Co., Boston, U.S.A., and for 30 years a member of this Society, died on September 29, aged 64 years.

From Germany are announced the following deaths:—Prof. Lassar-Cohn, of Königsberg, aged 64 years, who, besides contributing to the development of organic chemistry, achieved a well-earned reputation as the author of several books on chemistry written in a popular style. W. P. L. Beth, the author of the Halberg-Beth system of purifying blast-furnace gases, died in Lübeck on August 27; and Dr. H. Schelenz, the historian of pharmacy, died on September 28 in his 75th year.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for October 12 and 19)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Australia ..	Castor oil	402
" ..	Pottery, glassware, fibre-board ..	411
" ..	Dry colours	412
" ..	Glassware	412
Brazil ..	Paint, glazed bricks	412
Burma, Ceylon, Far East ..	Perfumery, pharmaceutical preparations, linseed and paint oils	439
Canada ..	Copper, galvanised and insulated wire, lighting glassware, tungsten-lamps, glass- and porcelain-insulators	9640 E.D./E.C.
" ..	Tinplate	9785 E.D./E.C.2.
" ..	Galvanised sheets	421
Denmark ..	Crude rubber	16025 F.W./M.C.
France ..	Tin-coated paper, fancy, kraft and printing paper	443
Guatemala ..	Earthenware	398
Mexico ..	Drugs	399
" ..	China, earthenware	225/48 F.G./M.C.
Panama ..	Glass, glassware, pottery	429
Poland ..	Tin, copper, antimony, bearing metals, solder, steel, lead, coloured glass, cylinder oil, zinc white, white lead	9720 E.D./M.P.
South Africa ..	Tar or tar substitute (tender for) ..	388
Switzerland ..	Chemicals for the paper, textile and tanning industries	225/51 F.G./M.C.
Syria ..	Glass, glassware, pottery	225/4 F.G./M.C./C.
United States	Pottery	

* Official Secretary, Commercial Bureau, Australia House, Strand London, W.C. 2.

† Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

TARIFF CUSTOMS EXCISE

Australia.—"Anti-dumping duties" have been applied to dairy thermometers and 4711 eau-de-cologne. An Act amending the Customs Act provides that *ad valorem* duties are to be based on the value of the goods in the exporting country or on the price f.o.b. paid by the Australian importer, whichever is higher. If the currency of the country of origin has depreciated to less than one-twelfth of its normal value, the *ad valorem* duty is replaced by a duty representing the difference of the cost plus duty plus profit in Australia and the wholesale price of similar goods made in Australia.

Ceylon.—Details of the proposed new customs tariff are given in the issue for October 19. Goods affected include acetic acid, cement, certain wares of glass, many metals, lubricating oil, perfumery, salt, soap, and sugar, but research chemicals and apparatus, copra, coconut oil, fertilisers, non-ferrous metals, unwrought metals, petroleum, quinine, crude rubber are not affected. The export duties on areca nuts, coconut products, plumbago, and rubber are also to be revised.

Estonia.—The export duties on gold, silver, platinum and wares thereof have been revised.

France.—Goods bearing any mark suggesting that they are of French origin may not be imported unless bearing the name of the country of origin.

Gold Coast.—The differential export duty on palm kernels has been abolished.

Italy.—An export licence is no longer required for potassium permanganate or for small quantities of sugar.

Mexico.—The import duty on lard has been modified.

New Zealand.—Regulations have been issued controlling the importation, sale, etc., of opium, morphine, heroin, cocaine, codeine, or ecgonine.

Northern Rhodesia.—Revised rates of duty have been applied to crown corks and stoppers, biroscope films, medicinal preparations, essences, syrups, tinctures containing over 3 per cent. of proof spirit, and starch.

South Africa.—Rebates are allowed on the duties payable on oils, gums, turpentine, solvent naphtha, "Sealtite" and similar fluxes, when imported for industrial use.

Spain.—Under the commercial convention made with Norway, reduced import duties are applied to cod-liver and other animal oils, synthetic nitrogenous compounds, oxalic acid, commercial oxalates, and nitrate of soda.

United States.—A partial reprint of the new customs tariff is given as a supplement to the issue for October 12.

Vladivostok.—The following rates of export duty, based on the local market value, have been fixed:—2½ per cent.: Beeswax, calamine, zinc blende, copper ore, scrap metals, glassware; 10 per cent.: wolframite, nickel, cobalt, manganese ores; 5 per cent.: other goods, except linseed, pottery, and bricks, which are duty-free.

Mandated Territories.—By an Order in Council, dated October 13, from November 1 the Tanganyika Territory, the British Sphere of the Cameroons, and the British Sphere of Togoland, will be included within the definition of the British Empire for the purposes of Section 8 of the Finance Act, 1919, which confers preferential rates of duty on goods grown, produced or made within the British Empire.

REPORTS

FIRST ANNUAL REPORT OF THE SECRETARY OF MINES FOR THE YEAR ENDING DECEMBER 31, 1921, AND THE ANNUAL REPORT OF H.M. CHIEF INSPECTOR OF MINES FOR THE SAME PERIOD. *Mines Department. Pp. 181. H.M. Stationery Office, 1922. Price 6s. 6d.*

This report, which marks the completion of the first year of the existence of the Mines Department, contains, in addition to the report of H.M. Chief Inspector of Mines, a review of matters outside his province. Part I is devoted to a review of the coal-mining industry during 1921, of the effect of the coal stoppage, and of the scheme of organisation which brought the dispute to an end. The number of mines working under the Coal Mines Acts increased from 2851 to 3045; the number worked under the Metalliferous Mines Acts fell from 498 to 383, and the number of quarries decreased from 5179 to 5466. Workers employed at the mines under the Coal Mines Act numbered 1,156,938 (including 924,649 workers underground) and at the quarries 69,979. The numbers of persons killed and injured in accidents were 768 and 86,888, respectively, including 756 fatal and 86,352 non-fatal accidents at coal mines.

The output of minerals in the United Kingdom is shown in the appended table:—

	1921	1920
	Long tons	
Coal	163,251,181	229,532,081
Iron ore, ironstone ..	3,477,955	12,706,895
Bauxite	2,269	11,020
Copper ore, dressed ..	36	81
Copper precipitate ..	190	194
Gold ore	—	1
Lead ore, dressed ..	6,787	15,399
Manganese ore	514	12,875
Tin ore, dressed ..	1,078	4,858
Tungsten ore, dressed ..	—	94
Uranium ore	76	60
Zinc ore, dressed ..	814	5,064
Alum shale	2,840	5,539
Arsenic, white and soot ..	1,032	1,997
Arsenical pyrites ..	—	1,178
Barium compounds ..	24,669	64,150
Bog ore	817	2,179
China clay	435,844	777,511
China stone	34,886	73,102
Chromite of iron ..	—	1,100
Fluorspar	23,137	54,683
Fuller's earth	20,242	28,906
Gypsum	264,840	286,078
Iron pyrites	3,943	6,650
Lignite	—	150
Natural gas (cb. ft.) ..	100,000	95,000
Ochre, amber, etc. ..	10,310	15,537
Oil shale	1,866,896	2,842,582
Petroleum	342	375
Salt	1,382,020	2,158,370
Soapstone	—	361
Sulphate of strontia ..	6,622	4,183
Chalk	3,434,357	3,747,165
Chert, flint, etc. ..	45,641	84,303
Clay and shale	8,351,450	8,021,434
Fireclay	1,352,587	1,966,040
Gravel and sand	2,480,817	2,757,052
Igneous rock	5,740,614	5,620,691
Limestone	7,335,862	11,227,817
Gamster	150,562	310,019
Sandstone	1,884,550	1,873,797
Slate	237,359	215,269

Total (excluding natural gas) 201,999,903 .. 284,601,174

* Cannot be stated.

The decline in the total value of the mineral production from £427,444,884 in 1920 to £231,681,353 in 1921 reflects the reduced output due to low prices and high working costs.

Coal.—The average net selling-value fell from 34s. 6·97d. in 1920 to 26s. 2·23d. in 1921. At the close of the year, both the output per man-shift and the export improved. The total electric power used

in coal mines was 1,148,103 h.-p., an increase of 67,281 h.-p., and the number of coal-cutting machines rose by 188 to 5259, but the output of coal by machine-cutting fell from 30,194,306 t. to 23,039,705 t. The total quantity of coal shipped abroad was 37·7 million t., leaving 129·1 mill. t., including 3·5 mill. t. of imported coal or its equivalent in coke, for home consumption (185·8 mill. t. in 1920), or 55 cwt. per head of population. Coal carbonised at coke ovens amounted to 6,835,940 t., and at gas works to 16,651,757 t., the output of coke being 4,575,618 t. and 6,793,492 t. (excluding coke used in the gas works), respectively. The number of coke ovens in use fell from 15,400 to 13,026, of which 4041 were beehive and 8146 by-product ovens.

Iron.—Owing to the collapse in prices and the coal stoppage, the production of iron ore, and of iron and steel was very greatly reduced. Retained imports of iron ore totalled only 1,887,642 t. Returns for the pig-iron industry in 1920 and 1921 are appended:—

	1921	1920
Works in operation ..	117	116
Furnaces built	486	481
Furnaces in blast (average) ..	95½	284½
Pig iron made .. (tons)	2,616,300	8,034,717
Iron ore used	5,604,093	19,137,460
Coal used	651,077	2,062,370
Coke used	3,075,947	10,036,219

Tin Ore.—Tin mining practically ceased early in 1921, but as the cost of fuel, materials, and wages has gradually fallen, it appears probable that work in mines that have kept their pumps going will be resumed when the price of metal improves slightly.

Zinc Ore.—There was no market for zinc concentrates during the year, and the zinc-smelting plants were at a standstill. Consequently the mines which produce chiefly zinc blende remained closed.

Manganese Ore.—The mining of manganiferous ore has almost ceased owing to its low grade.

Oil-shale.—There are 31 oil-shale mines in Scotland with a normal annual output of 3 mill. t. of shale, yielding about 60 mill. gallons of crude oil and 55,000 t. of ammonium sulphate. Many of the mines had to be closed during the coal stoppage and have not yet been reopened owing to the fall in price. The value of the products from one ton of shale was 29s. in January and 16s. in December.

Petroleum.—The petroleum well at Hardstoft is the only one now producing in England, all the others having been plugged and abandoned. Oil has been struck at the D'Arcy boring in Scotland and the West-Calder well is being plugged. Oil-fields of England, Ltd. is prospecting for petroleum near Kelham, Notts.

Metals.—Figures showing the production of metals from home-produced ores and the mean monthly prices during 1921 are given below:—

	Production		Average monthly price during 1921	
	1921	1920	£	s. d.
Copper (tons)	72	127	—	—
Standard	—	—	60	8 8
Electrolytic	—	—	75	1 1
Best selected	—	—	71	11 7
Iron, pig (tons)	1,071,120	3,952,692	—	—
Cleveland No. 3 ..	—	—	7	1 11
Lead (tons)	5,158	10,961	22	14 6
Tin	679	3,065	165	8 2
Zinc	292	1,655	26	4 1
Gold (fine oz.)	—	—	34·5	—
Silver	12,220	76,344	—	—

An important event of the year was the appointment of the Safety in Mines Research Board, to advise the Secretary for Mines on research work

and to supervise its execution. The chief subjects investigated at the Eskmeals Experiment Station included the propagation of flame; the ignition of gaseous mixtures; the spontaneous combustion of coal; tests of mining apparatus and miners' lamps. No large-scale work was carried on, owing to lack of funds. A joint committee of the Department of Scientific and Industrial Research, the Chemistry Co-ordinating Board, and the Safety in Mines Research Board has undertaken an inquiry into the adequacy of the tests for permitted explosives. Research on miners' lamps was continued.

The retained imports and the exports of British minerals and their products in 1921 were as follows:—

	Imports retained	Exports
	Tons	
Iron ore (except chrome iron ore and pyrites)	1,887,642	1,566
Copper ore	24,338	242
Copper manufactures	80,792	20,330
Copper sulphate	11	27,097
Lead ore	819	3,857
Lead manufactures	122,451	15,998
Lead, red	1,050	2,588
Lead, white	3,463	6,182
Tin ores and concentrates	20,277	199
Tin manufactures	6,314	10,877
Zinc ore	5,945	1,416
Zinc, crude and manufactured	72,265	7,343
Zinc oxide	4,431	740
Cement	105,484	230,736
Clay, all kinds	5,539	325,303
Fluorspar	—	5,220
Salt, table	3,744	1,518
Salt, other	81,260	239,573
Strontianite, celestine	—	5,795
Talc, steatite, soapstone, unground	2,610	—
Talc, steatite, soapstone, ground	3,867	237

* Figures not available.

REPORT ON THE ECONOMIC SITUATION IN THE NETHERLANDS EAST INDIES, TO MARCH, 1922. By H. A. N. BLUETT, *British Commercial Agent, Batavia. Department of Overseas Trade. Pp. 92. H.M. Stationery Office, 1922. Price 2s. 6d.*

Agriculture in the Netherlands East Indies progressed continuously until 1920, but since then trade depression has made necessary a reduction in the area under estate cultivation, particularly on rubber, tea and coffee estates. Agricultural research has been continued, however, and progress has been made in cultivating oil-palms and cotton; large areas of jungle in Sumatra have been cleared for planting cinchona, and other developments are proceeding. Sugar is the principal export of Java, and the sale of the output of 148 of the 183 sugar factories is controlled by the United Java Sugar Producers (*cf. J.*, 1922, 402n). Some 800,000 acres are now planted with Hevea rubber. Cinchona production is controlled by the Kina Bureau and the British Combine of Cinchona Planters in Java; the former controls, roughly, 45,594 acres planted to cinchona, and sells the output to the Bandoengsche Kininefabriek, which produces over 80 per cent. of the world's consumption. The British combine controls 3407 acres and sells its produce to a manufacturer in the United Kingdom. Production of bark from uncontrolled plantations is small, but several plantations will in time have a large output. The export of cinchona bark from Java and Madura in 1921 was 4601 metric tons (*cf. J.*, 1921, 356n) and of quinine 281.6 t. (310.3 t. in 1920). So far plantations of the oil-palm have been made only in Sumatra, where 22,230 acres have been planted; in

1921 the output was 2314 t., and the industry is gradually being established. The important copra industry is mainly in native hands; the factories established for extracting coconut oil during the war are finding difficulty in competing with European factories, as it pays better to export copra than oil. In 1921 exports of copra from Java and Madura amounted to 93,009 t., and from the other islands to 66,807 t., compared with a total of 182,000 t. in 1920.

Petroleum, coal, tin, gold, silver and iodine are produced in important quantities, and manganese, iron, nickel and copper ores, magnesite, phosphate rock, trass, sulphur and diamonds are either produced in small quantities or offer prospects of development. The petroleum resources are not so great as those of America, but the production is steady and will probably remain constant for many years. Development of petroleum and minerals is discouraged by the new mining law, which reserves a large share of any profit to the Government. The output of coal is increasing steadily and reached 1,117,432 t. in 1921; if the output continues to increase, external markets will have to be sought. Two gold and silver deposits in the Residency of Benkoelen (Sumatra) are being developed by the State, and a rich deposit of copper has been found at Tanim (Dutch Timor), but a body of ore sufficient to warrant exploitation has yet to be discovered. A deposit of iron ore, estimated to contain 5 million t. of surface ore and 155 million t. of clay ore, has been discovered in the island of Celebes near abundant water-power; the dry ore contains 48 per cent. of iron, 6.5 per cent. of aluminium and 10 per cent. of moisture. In 1920 there were produced: gold 8,864,771.3 fine oz.; silver 102,027,820.7 fine oz.; manganese ore 4179 t.; tin 2072 t.

The Government has fostered the establishment of new industries. Progress has been made in the manufacture of edible oils and of soap, factories for making firebricks, bricks and tiles, paint, etc. have been established, chemical industry is developing, and oxygen, carbon dioxide, iodine, sodium bisulphate, carbon bisulphide, calcium carbide, and pyrotechnical compounds are being made on a limited scale. An iron and steel works is being built at Cheribon by German interests, a paper mill with an (annual) capacity of 3000 t. is under construction, as are also a blast furnace in Sumatra and a lead factory at Gedangan. A British-Dutch-Norwegian combine is considering the erection of a factory for making synthetic fertilisers.

In 1920, the latest year for which statistics are available, exports from the Dutch E. Indies reached the record value of 2,254,000,000 guilders (guilder = 1s. 8d. at par, now about 1s. 9d.), of which 47.1 per cent. was for sugar and molasses, 8.9% for rubber and gutta-percha, 11.7% for tobacco, coffee and tea, 4.1% for quinine, 0.4% for cinchona bark and 25 per cent. for minor agricultural, mineral and forest products. Since the war new markets have been found in the United States, Australia, and the Far East, and the future is regarded with optimism. Imports in 1920 were valued at 1,116,200,000 guilders, derived, in order of importance, chiefly from the United Kingdom, the United States, Japan, and Singapore. Import statistics for 1921 will probably show a heavy reduction both in quantity and value. At present there is a growing demand for textiles, chemicals, paints, leather, earthenware, porcelain, glass and

glassware, but the market for iron and steel is dull. Great Britain, Germany, the United States and Japan are competing keenly in the chemical trade, imports from Japan are decreasing, and Germany has almost recovered her pre-war position. British trade in the Dutch East Indies could be considerably increased, the market offering very great possibilities.

REPORT ON THE INDUSTRIAL AND ECONOMIC SITUATION IN CZECHOSLOVAKIA, DATED MAY, 1922. By R. H. B. LOCKHART, *H.M. Commercial Secretary, Prague. Department of Overseas Trade.* Pp. 44. *H.M. Stationery Office, 1922. Price 1s. 6d.*

Since the publication of the previous report on Czechoslovakia (*cf. J.*, 1921, 372 R) this State has progressed further in construction problems. The good support accorded to a State loan floated in London and the establishment of an Anglo-Czech Bank in Prague are indications of the interest and confidence of English business men in the country. The continued decrease in purchasing power of neighbouring States has led to a crisis in the industry of the country, which relies on exports for its prosperity. This was, however, foreseen by most manufacturers, and no serious failures have occurred, nor are any anticipated. As a remedy strong efforts are being made to reduce wages and the cost of living. Glass holds third place in Czechoslovak exports for 1921. To extend their markets window-glass manufacturers have formed two sales organisations under the names of "Vitrea" and "Fenestra." In the spring of 1921 control of the sugar industry was taken over by a syndicate. The estimated output for 1921-22 is 650,000 metric tons. (For further details of the 1921-22 sugar trade *cf. J.*, 1922, 177 R, 315 R, 334 R.) The coal industry has suffered badly in the period under review, though the output in 1921 was slightly greater than in 1920. In 1921 the output of hard coal was 11.65 million tons, and of lignite 21 million tons. The position of the metal industry has also declined owing to high costs. Of the total 1921 imports, 3,961,716 metric tons, Great Britain supplied 2.5 per cent., and of the exports, 9,645,765 t., took 1.6 per cent. (*cf. J.*, 1922, 225 R). The quantities and distribution of certain groups of imports and exports in 1921 were as follows:—

Imports:—	Metric tons	Percentage distribution
Colours, dyes, tanning materials	17,882	Austr. 19, Yugoslav. 18, Ger. 11
Gums, resins	13,248	Ger. 37, Fr. 27, U.S. 12
Mineral oils, tar, coal tar	104,256	Pol. 72, Rum. 18
Glass, glassware	1,487	Ger. 85, Austr. 10
Chemicals, chemical products	168,005	Ger. 36, Belg. 11, Austr. 6
Exports:—		
Sugar	447,225	U.K. 21, Fr. 20, Austr. 14
Wood, coal, peat	7,632,092	Ger. 41, Austr. 38, Hung. 14
Colours, dyes, tanning materials	10,414	Hung. 48, Ger. 16
Gums, resins	17,755	Pol. 42, Ger. 27
Glass, glassware	132,741	Austr. 15, Italy 14, U.K. 11, Ger. 8
Chemicals, chemical products	62,485	Ger. 22, Austr. 21, Pol. 16

Official statistics give the value of the total imports and exports in 1921 as 22,435 million kronen and 27,312 mill. kr., respectively, leaving a favourable trade balance of 4877 mill. kr., as against 4185 mill. kr. in 1920 (present value of krone = about 1.7d.).

TRADE NOTES

BRITISH

Gold Coast in 1920

This colony enjoyed great prosperity during the first half of 1920, but the fall in price of cocoa—the chief article of export—from £122 to £39 per ton caused much financial distress and the export decreased by 51,403 tons to 124,773 t. Less attention was paid to the palm-oil industry and only 629,612 galls. of pericarp oil and 7664 t. of kernels were exported, compared with 938,595 galls. and 9892 t., respectively, in 1919. Special steps were taken to foster the copra industry along the sea coast, but the export of coconuts declined by one-half to 427 t. Exports of rubber fell by 58 per cent. to 134 t. and those of kola nuts declined slightly, the demand remaining good. The experiments on the cultivation of sisal and groundnuts and the production of shea-butter (*cf. J.*, 1921, 440 R) were continued.

Small diamonds of good quality were found in the lower Birrim valley and a company has been formed to exploit the diamondiferous area of the colony. An occurrence of gold recorded near Kwamang, in Eastern Akim, is not considered of economic importance. Deposits of low grade manganese ore were observed in the area north of Secondee.

Exports of domestic produce and manufactures were valued at £11,336,046, an increase of 22 per cent. and imports increased in value by over 90 per cent. to £15,152,145. The United Kingdom still holds the largest share of the external trade of the colony, but has not yet regained the pre-war position. Ground was gained by the United States, which supplied most of the imports of sugar, kerosene, iron and steel, perfumery, etc. and took a large share of the exports of lumber, manganese ore, and cocoa.—(*Col. Rep. Ann.*, No. 1119, 1922.)

Chemicals, etc., used by S. African Mines

According to the Union Department of Mines and Industries the values of the chemicals, etc. purchased for South African mines in 1921 were as follows:—Cyanide, £414,801; disinfectants, £21,692; explosives, £2,035,958; iron, and products of, £339,294; lead, £4,727; lubricants, £347,149; oils, non-lubricating, £15,268; paint, tar, etc., £39,004; steel, £617,079; zinc, zinc discs, £166,568.—(*U.S. Com. Rep.*, Sept. 11, 1922.)

FOREIGN

The Indigo Market in China

The chief dyestuff imported into China is synthetic indigotin, of which 90 per cent. is distributed in the form of 20 per cent. paste. It is estimated that 60 per cent. of the world's production of synthetic indigotin is consumed in China, and that the trade is worth nearly £2,000,000 per annum. Sales depend upon the price, as the Chinese use natural indigo if the price of the artificial product rises much above 40 taels per picul (equivalent to about 1s. per lb. in Aug., 1922). Stocks of indigotin-paste in China, excluding Hongkong, are being offered at 1s. 4d. per lb., and amount to about 6500 long tons, derived as follows (per cent.):—Germany 50, Switzerland 10, France 15, the United States 10, Germany ("reparation" deliveries) 15. Competition in the indigo trade depends upon the possession of an efficient sales organisation, and

these Swiss, French and American firms which are able to compete with the Germans have their own organisations on the spot. Stocks of British-made indigotin have been shipped back to England, probably because they were unsuitable for the Chinese market, but it is anticipated that the British indigotin will be a factor in this trade in the future.—(*U.S. Com. Rep., Sept. 18, 1922.*)

The Chilean Nitrate Industry

H.M. Consul at Antofagasta reports that 447,197 tons of nitrate was produced in Chile during the six months ended June 30, 1922, as against 851,239 t. during the same period of 1921. Exports declined from 785,362 t. to 279,034 t., of which about 36 per cent. was shipped to Europe and Egypt, and 50 per cent. to the United States. Consumption during the first half of 1922 is estimated at between 900,000 and one million tons, the Nitrate Pool alone having sold 590,000 t. out of 800,000 t. it held in stock at the end of December, 1921. At the end of June, stocks in Chile were estimated at 1,609,000 t., and in Europe and Egypt at 217,500 t. Many factories which reduced output during the recent crisis have completed their stocks and closed down. Only 33 factories were working at the end of June, but it is anticipated that trade will improve early in 1923.—(*Official.*)

Exports of Carnauba Wax from Brazil

Carnauba wax, used in making phonograph records, physical apparatus, etc. is obtained from a palm tree which flourishes in the hot, dry zones of north-eastern Brazil (*cf. J., 1921, 319 n*). The quantity and value of the exports during recent years have been as follows:—1918, 4215 metric tons, 20,432,956 milreis; 1919, 6224 t., 20,539,680 milreis; 1920, 3516 t., 10,873,046 milreis; 1921, 3906 t., 10,394,627 milreis (milreis=2s. 3d. at par, now about 65d.). The chief ports of shipment are Fortaleza in the State of Ceara, and Ilha do Cajueiro, in the State of Maranhao.—(*U.S. Com. Rep., July 17, 1922.*)

Proposed Capital Increases in the German Dye Industry

The capital of the Farbwerke vorm. Meister Lucius u. Brüning, Höchst, is to be increased from 470 to 940 million marks. Of the new shares to be created, there will be 400 million ordinary shares, participating in this year's dividends, which will be taken over by a bank at 150 per cent. and offered to existing shareholders on a share for share basis; and 30 million preference shares with dividend rights as from January 1, 1923, to be taken up by the other firms constituting the "I. G." (who also contemplate doubling their capital). The directors of the company are of the opinion that the company will be able to pay dividends commensurate with the increased capital.

The following table gives a survey of the capital increases during the last few years of the various companies belonging to the combine:—

In million marks	Oct., 1919		April, 1921		Dec., 1921		Sept., 1922		Dividends 1920-1921		Share of profits %
	O.Sh.	P.Sh.	O.Sh.	P.Sh.	O.Sh.	P.Sh.	O.Sh.	P.Sh.	1920.	1921.	
Höchst ..	180	72	400	30	440	30	880	60	20	30	24.82
Bad. Anil. ..	180	72	400	30	440	30	880	60	20	30	24.82
Bayer ..	180	72	400	30	440	30	880	60	20	30	24.82
Treptow ..	63	25	136	10	149	10	298	20	20	30	8.08
Gröschelm ..	45	18	100	8	110	8	220	16	10	27	6.0
Weller-ter-Meer ..	16.61	6.66	31	2.33	33.63	2.33	67.30	4.66	15	25	1.65
Cassella ..	81	32	152.20	—	152.20	—	304.40	—	20	3	9.81
Total ..	745.64	297.60	1,619.2	110.33	1,764.85	110.33	3,529.70	220.60			100

The Italian Market for Paint and Varnish

Most of the paint and varnish made in Italy is second-grade material. About 10 per cent. of the requirements in high-grade paints and varnishes is made in Italy, Great Britain supplying 70 and the United States 20 per cent. Germany practically controls the market for dry artificial colours, linseed oil and red lead are imported from Great Britain, rosins and turpentine from the United States, France and Greece, size from Great Britain and China, and wood oil from China. Most of the mineral colours needed are produced in the country. In 1913 Italy imported about 8500 m.t. of paints and colours and 3000 t. of varnish, but owing to trade depression the imports in 1920 fell to 6350 t. and 2250 t., and in 1921 to 4400 t. and 1158 t., respectively.

The World's Trade in Dyestuffs

The following statistics concerning the world's trade in colours and dyestuffs is based upon the classification adopted by the United States. This classification includes coal-tar dyes, turpentine, linseed oil, chalk and crayons.

Exports in 1920:—		Value \$	Destination Per cent.
United States ..	28,000,608	..	America 56, Europe 26, Asia 8.7, Austral. 7.1, Afr. 1.6
England ..	25,093,000	..	Brit. Col. 35, Europe 35
Germany ..	9,679,000	..	Chiefly Europe
France ..	5,271,000	..	Europe, Egypt
Holland ..	6,776,000	..	Belgium, U.K., France, Dutch E. Indies
Japan ..	3,815,000	..	China 60, Rest of Asia 40
Canada ..	1,756,000	..	U.K. 70, U.S.A. 30
Imports in 1920:—		Value \$	Origin Per cent.
England ..	9,791,000	..	U.S.A., Can., France, Holl., Germ.
Holland ..	3,999,000	..	Germ. 74
France ..	2,324,000	..	U.K., Holl., U.S.A.
Italy ..	1,034,000	..	Germ., U.K.
Sweden ..	1,599,000	..	Germ., U.K.
Switzerland ..	1,385,000	..	Germ. 50, France 25
Spain ..	1,323,000	..	U.K. 50, Germ., U.S.A.
Norway ..	1,112,000	..	Germ., U.K.
Denmark ..	1,101,000	..	Germ., U.K.
Canada ..	4,251,000	..	U.S.A. 83
British India ..	6,661,000	..	U.K. 80
Brazil ..	4,392,000	..	U.S.A., U.K.
Argentina ..	3,817,000	..	U.S.A., U.K., Germ.
New Zealand ..	2,756,000	..	U.K. 40, Austral. 30, U.S.A. 15
Cuba ..	2,384,000	..	U.S.A. 84
South Africa ..	2,221,000	..	U.S.A., U.K.
China ..	2,000,000	..	Japan 60, U.K., U.S.A.
Philippines ..	1,743,000	..	U.S.A. 90
Australia ..	1,679,000	..	U.K. 60, U.S.A. 30
Egypt ..	1,560,000	..	U.K. 50, France 25
East Indies ..	1,470,000	..	Holl. over 67
Chile ..	1,200,000	..	U.S.A. over 50, U.K.
United States ..	<1,000,000	..	—

In 1913 Great Britain, Germany, and the United States were the chief countries exporting dyestuffs, their exports being valued at \$15,000,000, \$15,000,000 and \$7,328,000, respectively, and this position was maintained during 1920. In 1921 prices fell heavily and the value of the exports during the first ten months of the year fell to \$10,437,000 for the United States and to \$8,818,000 for Great Britain, compared with \$24,058,000 and \$13,339,500, respectively, for the same period of 1920. The value of the world's trade in dyestuffs during 1921 was less than one-half that in 1920.

REVIEWS

CHEMICAL TECHNOLOGY AND ANALYSIS OF OILS, FATS AND WAXES. By J. LEWKOWITSCH. Sixth edition. Vol. II. Entirely revised by G. H. Waiburton. Pp. xii.+959. London: Macmillan and Co., Ltd., 1922. Price 42s. net.

The many and widespread interests which are concerned with the preparation and use of oils, fats and waxes, are of such magnitude, and their national importance so great, that they rank amongst the great industries of the Empire. The working-up of the prime raw materials, the production and preparation of which are of the utmost importance to many, if not all of our Colonies, involves such an amount of capital and labour that there exists every justification for the production of an encyclopaedic treatise which should contain a statement of all modern improvements in the production, purification and manipulation of the various oils, fats and waxes, as well as the fullest details as to their analysis, composition and properties.

Dr. Lewkowitsch's book is the only work in our language which approximates to this standard, and his wide experience enabled him to write with authority on the subject. There can be no doubt that his death before he had completed any more than the first volume of the fifth edition of his book, which appeared in 1914, made it extremely difficult to maintain in the later portion of that, and also any subsequent editions, the high standard which he had set. So long as the living personality of the author was behind his writings, the peculiar style and diction which he adopted could be accepted, they were characteristic of the man, but it is to be regretted that they have been retained in the edition now current which bears a date eight years after the author's decease.

It may be questioned always how far a revision should involve alterations of text, but if revision is to be anything more than reprinting, then statements in the older editions which refer to periods of time should be amended. In very many cases throughout the volume now under review such wording as "during the last decade," "during the last few years," "recently," is found in sentences which have been changed in no way since they appeared in the 1909 edition. If any reason could be advanced for their appearance in the 1914 edition, surely none can be put forward for their presence in the new publication of 1922. Most of the statements so introduced have no bearing whatever on current conditions.

The volume contains two chapters. The first, which consists of 39 pages only, deals very briefly with the commercial preparation of the raw materials used in the oils, fats and waxes industries. It is to be regretted that so important a branch of the industry receives such scant attention, and especially is this so when up-to-date plant and practice are ignored. Only two examples of this need be cited. The paragraph on p. 16, dealing with the Anderson "expeller" continuous oil-press, although introduced by the word "recently," has not been altered since it appeared in the 1909 edition, and it altogether ignores, in its possibly justified condemnation of the press for the purposes indicated, its more modern and quite extensive application, especially in American practice, to the preliminary crushing of such oily materials as copra.

Further, the square box-press, which has largely superseded the circular cage-press for the pressing of palm-kernels and copra, both in this country and abroad, is not mentioned.

The second chapter, which forms the major portion of the volume, consists of a series of monographs dealing with the principal oils of commerce, whilst lesser known oils are described in short paragraphs or tables. This undoubtedly is the most useful part of the volume, since it contains practically all the published information concerning the materials about which it treats, though it might be claimed that much of the older matter could be eliminated without any sacrifice of utility.

The outstanding need of the volume is an alphabetically-arranged index of its contents. In previous editions a general index has been appended to Vol. III of the work, and it is to be presumed that this will be continued, but the inconvenience of referring to an index in one volume in order to locate matter contained in another is obvious. The indexes of botanical and zoological names contained in this volume are of somewhat doubtful utility. In spite of the above-indicated shortcomings, the appearance of this volume must be welcomed by everyone who is concerned with industries involving a knowledge of the preparation and properties of oils, fats and waxes, as a large proportion of the information contained in it is not obtainable elsewhere without an immense amount of labour and extensive reference to innumerable other publications. From this point of view the work is most valuable.

JOHN ALLAN.

FOURTH REPORT ON COLLOID CHEMISTRY AND ITS GENERAL AND INDUSTRIAL APPLICATIONS. Pp. 382. London: H.M. Stationery Office, 1922. Price 5s. 6d. net.

This report, which is issued by a Committee of the British Association for the Advancement of Science under arrangement with the Department of Scientific and Industrial Research, is similar in plan to the three reports already issued, the subject-matter being arranged under two heads, namely, (1) classification according to scientific subject; (2) classification according to industrial process. The sections included under the first head are:—"Colloid Problems in Analytical Chemistry," by H. Bassett; "Cataphoresis: The Motion of Colloidal Particles in an Electric Field," by E. F. Burton; "Colloid Systems in Solid Crystalline Media," by C. H. Desch; "Molecular Attraction and the Physical Properties of Liquids," by Edwin Edser; "Membrane Equilibria," by W. E. Garner; "Disperse Systems in Gases," by W. E. Gibbs; "The Theory of Lubrication," by W. B. Hardy; "Application of Colloid Chemistry to Mineralogy and Petrology," by Alex. Scott.

The technical papers included under the second heading are:—"The Colloid Chemistry of Soap. Part II. The Soap Boiling Processes," by J. W. McBain and E. Walls; "The Concentration of Ores by Flotation," by Edwin Edser; "Colloids in Catalytic Hydrogenation," by E. F. Armstrong and T. P. Hilditch; "The Role of Colloids in Electrolytic Metal Deposition," by H. J. S. Sand; "Rubber," by H. P. Stevens; "Colloidal Fuels, their Preparation and Properties," by A. E. Dunstan.

If the various scientific and technical journals published during the last few years are examined only cursorily, one cannot fail to notice that colloid chemistry is attracting more and more attention, as is indicated by the large number of papers dealing with various aspects of the subject. This increased interest is indicated by the fourth report, which contains more than twice the number of pages in the third report.

With advance in knowledge it becomes increasingly difficult to offer a definition of colloid chemistry. Such substances as the proteins have been looked upon as typical emulsion colloids, but in recent years it has been shown that many of their properties can be explained by the application of ordinary stoichiometrical relations. Again, the work of Laue and Bragg, Langmuir, etc. indicates the existence of residual valencies at the surface of solids, and this, together with an increase in knowledge of the laws underlying the formation of complexes, will undoubtedly throw fresh light on the subject of adsorption, a subject which is particularly dear to the colloid chemist. This difficulty of definition is indicated by the subjects included in the present report, since some of them a few years ago would undoubtedly have been classed as pure physics and not as colloid chemistry.

A decade or so ago it was considered that the various processes of analytical chemistry could be explained by the application of the dissociation theory. Difficulties were then glossed over; now one endeavours to meet many of them by a consideration of the colloid chemistry involved. Prof. Bassett discusses the fundamental colloid phenomena underlying many analytical operations, especially in connexion with the formation, purity, filtration and washing of precipitates. Attention is also called to a phase of the subject which is generally neglected, viz., the colloid properties of filter paper, surfaces of vessels, etc., and there is a valuable section which illustrates the application of the principles discussed to various important analytical estimations.

In the section on cataphoresis, Prof. Burton summarises the main points of the subject, and includes recent work on technique carried out in his laboratories.

The dispersion of solid particles throughout a crystalline solid, when the state of sub-division is sufficiently fine, introduces colloidal characteristics of interest in metallurgy and mineralogy. Prof. Desch writes a critical article on the application of our knowledge of colloids to such questions as the hardening of steel and of certain non-ferrous alloys, and the colouring matters in crystalline minerals. Very often the use of the blessed word "colloid" is considered to offer an explanation of a subject which is little understood, as was the case with the word "catalysis," but Prof. Desch is careful to point out where it is doubtful whether the solution of a problem is to be found in the application of colloid chemistry.

Mr. Edser's article on molecular attraction and the physical properties of liquids is different from the others in that it consists mainly of the development of a theory of the author's on the law of molecular attraction. It is found that in all liquids the result of analysing the experimental data is to indicate that the molecules attract each other inversely as the eighth power of the distance separating them. Expressions are deduced for calculating the

latent heats and surface tension of liquids. One of the assumptions made, and with which many will not agree, is that the molecules of a liquid and those of its vapour are identical in structure so far as association is concerned, and the degree of association does not vary with the temperature.

Mr. Garner discusses the potential differences occurring at the surfaces of membranes in contact with electrolytes, special attention being paid to Donnan's theory. Loeb has recently made extended use of the Donnan equilibrium in dealing with proteins, but this is not referred to. It would have been interesting to have had a criticism of Loeb's results by an independent worker on the subject.

Gas-solid and gas-liquid disperse systems are of importance in connexion with various natural phenomena, with industrial operations such as the precipitation of dust, and with chemical warfare, and Dr. Gibbs gives a valuable *résumé* of the results hitherto obtained and of the underlying theory.

Mr. Hardy discusses the various theories of lubrication and then gives an account of his own theory and work on the subject. Dr. Scott gives a very valuable bibliography and discussion of the application of colloid chemistry to mineralogy and petrology, and is careful to point out many directions in which further investigations are needed.

Prof. McBain and Mr. Walls give first a brief account of actual soap-boiling practice, then a theory of soap-boiling based on laboratory and semi-technical experiments, and finally the application of the theory to the several industrial processes. The authors state that "neither scientist nor experienced soap-boiler is in a position even now to give a connected and reasoned account of all the phenomena upon which this vast industry is based. Improvements are still effected by purely empirical trial." Nevertheless, the work of McBain and his collaborators at Bristol University, in which there is strict application of scientific method to an industrial problem, is making sure progress in the direction of eliminating empiricism. This report, together with Part I, goes a long way towards the objects aimed at, namely, a clear description of the experimental behaviour of soap and their solutions, and the development of a rational theory to account for them, so that ultimately the various factors can be controlled quantitatively.

Mr. Edser's article on the concentration of minerals by flotation is one which contains a considerable amount of original work and many new observations. It is thought-provoking and will undoubtedly give rise to much discussion and fresh experiment, since in many of his views he is totally at variance with many physical chemists, especially with Bancroft.

In the hydrogenation of gaseous or liquid organic compounds colloid phenomena are concerned: (1) because of the surface at which interaction occurs; (2) when catalysts in the colloidal condition are employed. The various physical and chemical conditions involved, as well as the various theories of catalysis, are considered and critically discussed by Drs. Armstrong and Hilditch.

The effect of colloids in giving bright and coherent deposits from electrolytic plating solutions is one which has long been known, but it is only comparatively recently that more or less satisfactory attempts have been made to give explanations of the phenomena. Dr. Sand gives an interesting summary of this subject.

Dr. Stevens's report on rubber is an extension of the first report published in 1917, the bibliography being brought up to date and the properties of rubber discussed from the colloidal view-point. The question of vulcanisation is treated in detail.

Dr. Dunstan's report on colloidal fuels is very brief, and refers, more particularly, to work done in the United States. It could have been expanded with advantage.

As will be seen from the brief summaries given above, the various reports are written by well-known workers on the subjects about which they write, and their importance to all who have to deal at some time or other with colloids cannot be over-emphasised. The results obtained in the study of colloid chemistry are now being utilised in so many branches of science, that the literature on the subject has become very scattered, and all interested in the matter owe a great debt to the special Committee of the British Association for the work it has done in arranging for the drawing up of such admirable and critical summaries.

T. SLATER PRICE.

MODERN GASWORKS' PRACTICE. By ALWYNE MEADE. *Second edition, rewritten and enlarged.* Pp. xi+815. London: Benn Brothers, Ltd., 1921. Price 55s. net.

If anything more were required to confirm that the industry concerned with town-gas manufacture is in the forefront of chemical-engineering industries—as regards size, capital value, extent of its ramifications, and the multiplicity of its opportunities for rendering national service—this book by Alwyne Meade would suffice. Those best able to judge tell us that there are very few chemical engineers amongst us: there are many able technical chemists who are poor engineers, and there are many excellent engineers engaged in the chemical industry who are very poor chemists. None but a fully qualified chemical engineer—in the idealistic sense—could have compiled and written this book on modern gasworks' practice. The author demonstrates unquestionably that he not only possesses a thorough theoretical knowledge of his subject but that he is in the closest association in an executive capacity with many of the processes, plants and operations described and excellently illustrated in this voluminous work. The book is well arranged, well bound and well printed, and the publishers are to be congratulated on their part of the work. We would, however, suggest that it would be an advantage if the *third* edition were published in two or three slightly smaller volumes, particularly as the author draws our attention to the fact that the bulk of the second edition is 50 per cent. greater than that of its predecessor; and "as yet there is no indication as to when finality in this direction may be reached."

The book justly claims to be one on modern gasworks' practice, and all the advances that have been made in the gas industry up to the middle of the year 1921 are faithfully and adequately handled. It would, however, have been better if the author had dealt less fully with obsolete plants and processes and if he had been contented with references to fuller accounts. Undoubtedly everything that is touched on is of great interest to particular specialists, but the subject of modern gasworks' practice is such an extensive one that

the author cannot afford space to make the book an historical treatise on the gas industry. The author depends, perforce, for much of his information relative to the results obtained in plants and processes on accounts published, in good faith, by interested parties. This is a misfortune that is not peculiar either to this book or to the gas industry.

As the volume of work done by such research committees as the Gas Investigation Committee rapidly increases, it will become less and less necessary to depend on, and refer to, the less reliable workers. A perusal of this book brings conviction that the gas industry no longer depends for its progress on the "practical" man alone—with his rule-of-thumb methods and lack of vision—but is now at long last making good use of scientifically-trained men.

One here realises, too, the enormous debt the industry owes to the Fuel Department of the Leeds University for the work, of immediate value to the industry, which has been carried out by members of its staff during the last fifteen years. Few industries are served by the universities so well as the gas industry, and it is an excellent and rejuvenating thing that this should be so. Mr. Meade creditably draws heavily for his inspirations from the reports on work carried out at the Leeds University—re-assembling their results in more digestible form—and enhances the value of his book proportionately.

"Alwyne Meade" should be found on the shelves of all progressive gas engineers and students, as it is an incomparable book of reference and text-book combined.

E. W. SMITH.

GRUNDZÜGE DER ANGEWANDTEN ELEKTROCHEMIE. BAND I: ELEKTROCHEMIE DER LÖSUNGEN. By PROF. GEORG GRUBE. Pp. xii+268. Dresden and Leipzig: Theodor Steinkopff, 1922. Price 8s. 6d. (10s. bound).

In many ways this book resembles Foerster's well-known "Elektrochemie wässriger Lösungen," but it is less detailed. It begins with 140 pages of theoretical principles, in the form usual in German text-books, and not always up-to-date. Thus, in considering dilution laws, no mention is made of Washburn's important experiments, and the work of Krüger and Krummreich on absolute potentials, although given extremely briefly without mention of the names, has no reference beyond Foerster's book. In other respects the literature references are usually good, and comprise work done in 1921.

The introductory section includes the lead and nickel-iron accumulators, the "combustion" cell, and electro-endosmose and its applications. The electro-deposition and refining of metals are next treated. The section on the electrolysis of alkali-chlorides (pp. 171–218), which deals with alkali, chlorine, hypochlorite, and chlorate, is very good; the descriptions of the principal cells are brief but clear, and numerical data are given when these are known. Electrolytic oxidation and reduction processes, the electrolysis of water, and the electrolytic prevention of boiler-corrosion follow, and there is a good index.

Prof. Grube's book is a very useful and concise text-book of the electrochemistry of solutions, and provides a readable account of an important branch of technology.

J. R. PARTINGTON.

OBITUARY

J. TAKAMINE

We are indebted to Dr. Allen Rogers, hon. secretary of the American Section, for the following facts concerning Dr. Takamine, an original member of this Society, who died in New York on July 22, aged 67 years.

Jokichi Takamine was born in Takaoka, Japan, and received his scientific and technical education in the Imperial Engineering College, now the Imperial University, of Tokyo, where he graduated in chemical engineering in 1878; later as a government student, he spent three years at the University of Glasgow. The degrees of doctor of engineering and doctor of pharmacology were conferred upon him by the Imperial University of Tokyo in 1899 and 1904, respectively. Among the many important positions he filled were those of chief chemist to the Department of Agriculture and Commerce, director of the Government Chemical Laboratory, and Patent Commissioner for the Empire of Japan. He founded the Government Saké Experimental Station, and also the Tokyo Artificial Fertiliser Co., which owns the first superphosphate works in the country; during Takamine's direction the capital of this company rose from 250,000 to 25 million yen.

Much of Takamine's best work was done in his private laboratory. He took out many patents on the improvement of *Moyashi* diastatic substances; he invented a process for extracting cobalt oxide from Japanese manganese ore which proved an invaluable aid to the pottery industry of Japan; and he developed the use of the improved *Koji* process in alcoholic fermentation. In the early 'nineties he settled in the United States, at Clifton, New Jersey, where he isolated the active principle of *Koji*, known as Taka-diastase, which has been much used in medicine, and also, under the name "Polyzyme," in the textile industry, in cereal foods and in baking. In 1900 he isolated adrenaline, the active principle of the suprarenal glands, which has found such a wide application as a hemostatic agent. He is also the inventor of a process, still in use, for recovering glycerin from printers' rollers.

Dr. Takamine received two orders from the Emperor of Japan, in one of which, the Fifth Order of Rising Sun, he rose to Court rank; he was also appointed, by Imperial Decree, a member of the Imperial Academy of Science in Japan, of which the active membership is limited to sixty.

PUBLICATIONS RECEIVED

THE MANUFACTURE OF DYES. By DR. J. C. CAIN. Pp. 274. London: Macmillan and Co., Ltd., 1922. Price 12s. 6d.

INORGANIC CHEMISTRY. By E. J. HOLMYARD. Pp. 560. London: Edward Arnold and Co., 1922. Price 6s. 6d.

A COMPARISON OF BRITISH AND AMERICAN FOUNDRY PRACTICE WITH SPECIAL REFERENCE TO THE USE OF REFRACTORY SANDS. By PROF. P. G. H. BOSWELL. Pp. 106. Liverpool: The University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd., 1922. Price 4s. 6d.

ATOMIC FORM WITH SPECIAL REFERENCE TO THE CONFIGURATION OF THE CARBON ATOM. By E. E. PRICE. Pp. 140. London: Longmans, Green and Co., 1922. Price 5s.

INVESTIGATIONS ON OIL PALMS. By DR. A. A. L. RUTGERS. Pp. 125. Medan, Dutch East Indies: Experiment Station, A.V.R.O.S., 1922. Price 10s.

THE VOLATILE OILS. By E. GILDEMEISTER and FR. HOFFMAN. Second edition, translated by E. Kremers. Vol. III. Pp. 777. London: Longmans, Green and Co., 1922. Price 32s.

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REVIEW

Vol. XLI]

NOVEMBER 15, 1922

[No. 21

UNVEILING OF THE RAMSAY MEMORIAL

THE medallion tablet to the memory of Sir William Ramsay was unveiled in Westminster Abbey on November 3, by H.R.H. the Duke of York, in the regretted absence of H.R.H. the Prince of Wales, who had met with a slight accident in the hunting field on the previous day. The tablet, executed in bronze by Mr. C. L. Hartwell, A.R.A., represents in profile the head of the great chemist; it is set in a marble frame and bears the simple inscription: "William Ramsay, Chemist." During the short and impressive service, the Duke of York removed the veil which covered the tablet, and said:—"On behalf of my brother I ask the Dean and Chapter to accept this tablet as a lasting memorial to Sir William Ramsay, the great chemist." In accepting the memorial, Bishop Ryle, Dean of Westminster, said that it would be the duty of the Dean and Chapter of Westminster to preserve the mural tablet, and to add it to the galaxy of memorials to distinguished men of science placed in the adjoining North Aisle and including those dedicated to the memory of Darwin, Wallace, Lister, Adams, Stokes, Joule, and Hooker.

There was a large and distinguished congregation. Lady Ramsay was present, with many of her family and relations. The officers of the Ramsay Memorial Fund were represented by the Rt. Hon. H. A. L. Fisher, Sir Charles Sherrington, the Rt. Hon. Lord Chelmsford (vice-presidents), Sir Hugh Bell (chairman), Prof. J. Norman Collie (treasurer), and Dr. W. W. Seton (organising secretary). The large attendance of the Diplomatic Corps included Ambassadors (United States, France, Belgium, Japan, Spain, Germany); Ministers (Chile, Denmark, Finland, Greece, Lithuania, Netherlands, Serbia, Sweden); *Chargés d'Affaires* (China, Norway); representatives of the Italian Ambassador and the Swiss Minister; and several Consuls-General. Among the many representatives of Science were Prof. H. Le Chatelier (delegate of the French Academy of Sciences), Sir W. Bayliss, Sir G. Beilby, Sir W. Bragg, Prof. F. G. Donnan, Prof. F. E. Francis, Sir R. Glazebrook, Sir R. Gregory, Sir R. Hadfield, Sir H. Jackson, the Hon. Sir Charles Parsons, Prof. J. R. Partington, Sir R. Robertson, Prof. S. Smiles, and Dr. M. W. Travers. It had been arranged that His Excellency the French Ambassador should present the Prince of Wales with the Gold

Medal of the Ramsay Memorial Fund, but this ceremony had necessarily to be postponed.

We take advantage of this occasion to offer our tribute to the memory of our Past-President, from the pen of one of his most distinguished pupils, Dr. Morris Travers, who was intimately associated with him in the discovery of neon, krypton and xenon.

WILLIAM RAMSAY

The beautiful ceremony in Westminster Abbey on November 3, was the world's homage to the genius of one of the greatest scientists of our time. His name is enrolled with those associated with the highest achievement by men of our race; it passes into history. Though much has been written on Ramsay's life and work since his death in 1916, it may still be permitted to those who were associated with him, many of them members of this Society of which he was onetime President, to pay personal tribute to the memory of their well-loved friend and leader.

To one who was privileged to serve him for many years it seems that the quality in Ramsay's nature which drew men to him, was his unshakable belief in human integrity. Suspicion and distrust were absolutely foreign to him. Never did a student appear so worthless but that Ramsay had hopes for him. Over-confidence in associates may have led to the exploiting of his name, to his own grief and annoyance; but in his confidence in the reliability of fellow scientists lay the springs of some of his greatest successes. The discovery of argon, the discovery of helium, the part he played in the development of the chemistry of radio-active substances, had their origin in the belief that the facts stated by Lord Rayleigh, Hildebrand, and Rutherford, were worthy of acceptance and investigation, and were not mere errors of experiment. In pursuing investigations, those who served him knew that they had his entire confidence, demanding only an equal confidence in themselves, and in him. Scientific friends, students, and colleagues were freely admitted to his laboratory, in which there were no secrets.

It has been suggested that Ramsay was *lucky* in his scientific career. Nothing is further from the truth. He had hardly the advantage of a university training in the modern sense of the term. While in Germany he studied in a laboratory in which originality was at a discount. At Bristol he was loaded with the work and responsibility falling on the shoulders of the

Principal of a small and struggling college. In 1887 he took over the laboratory at University College in which research was a dead letter, and when the spirit of research throughout the country was at a low ebb. Yet in ten years he had built up a school of chemistry which drew students and investigators from all parts of the world.

Ramsay's early work, carried out under considerable difficulties in University College, Bristol, consists mainly of a series of brilliant experimental researches on the properties of liquids and vapours, with occasional excursions into other fields. During his early years in London he completed some of these investigations, carried out some important work on the molecular weights of liquids, and other researches in which his students took part. The building-up of a school of research was the object which he had in view, but he did not bind himself to any particular line of investigation. He wrote a large text-book of inorganic chemistry, undertaking this work partly with the view of arranging and systematising contemporary knowledge of inorganic chemistry on the basis of the Periodic Law. One edition only appeared, and it was never revised or rewritten. It is of historical interest, as the Periodic Law was the basis of some of his greatest discoveries.

During the early nineties the development of the new theories of solution gave a fresh direction to the study of chemistry, and Ramsay became keenly and critically interested in the work of the Continental school of chemists, which at the time, found many opponents in this country. He was not, however, inclined to follow in other men's footsteps. Students in his laboratory worked at problems relating to solutions; but, although he was then easting about for new lines of research he did not take an active part in this work. It was Lord Rayleigh's observation of the abnormal density of atmospheric nitrogen which provided the key to the series of discoveries which occupied his individual attention for the last years of the century, and which determined the future course of his investigations.

Reading the original "argon" paper, one is impressed by the fact that, even when it was written, Ramsay realised that he stood on the threshold of greater discoveries. The discovery of helium, the logical sequel to the discovery of argon, confirmed him in the belief that these gases formed members of a series of terrestrial elements, and in the autumn of the year 1895 he definitely embarked on the search for the missing members of the group. Two years later, in his address to the Chemical Section of the British Association at Toronto, he took the characteristic step of describing the progress of the search for the "undiscovered gas," predicting its properties, and inviting competition in the quest. Three years after the discovery of helium the reward came to him in

the simultaneous discovery of neon, krypton and xenon, but it was only after two further years of strenuous work that the five "rare gases" were completely isolated and their properties fully described. The isolation of niton many years later set the crown on this work.

These discoveries had their origin in Ramsay's power of grasping the significance of facts observed by others rather than of passing them over as possible errors of experiment. The development of them was based upon a clear understanding of the simple fundamental laws of chemistry. The conduct of the long drawn-out investigations, in face of real difficulty and often of adverse criticism, called for enthusiasm, courage, and perseverance, and the character of the work demanded experimental skill of the highest order. These qualities Ramsay brought to bear on his researches, and with them he in some measure endowed those who served him.

Space does not admit of further reference to Ramsay's scientific researches, nor to his activities in connexion with scientific and educational organisations. Suffice it to say that the election of the man most renowned for his investigations in the domain of scientific chemistry to the office of President of this Society, and his acceptance of that office, may be regarded as a landmark in the history of the relations of British science and British industry, which he did much to foster.

In building up the school of chemistry at University College, and in maintaining the spirit which pervaded it, Ramsay's personality was a dominating factor. Even in his busiest time he rarely failed to make a daily tour of the laboratory, seeing all but the junior students, and having a word of advice or criticism for everyone. To the juniors he lectured personally, and would often visit the practical classes. Every student who passed more than a year in the department was in turn invited to one of his Saturday evening dinners, and made to feel that he was a friend in whom the Chief and Lady Ramsay took a personal interest. Letters from former students and assistants invariably met with a cheery reply, generally containing something new and interesting.

Many of Ramsay's greater discoveries are, in a sense, complete in themselves. They were the forerunners of many recent advances in science and technology, which are based on the foundation which he laid. During the last two years of his life, years of war, he devoted more attention to matters affecting science and the Empire than to experimental chemistry. Had he lived we may believe that he would have been an active force advocating and promoting the principle of frank co-operation between men of science, and between those engaged in science and industry.

MORRIS W. TRAVERS.

SOME RECENT WORK ON ANTHELMINTICS

T. A. HENRY

IN a recent report Dr. F. A. Miller states that in the course of the anti-hookworm campaign, of which he is director, in Colombia, out of 53,390 persons examined in 1921, 49,940 (93 per cent.) proved to be infested and that of 47,822 treated, 37,488 (78 per cent.) were cured. This report relates to the work of one of the many similar campaigns against hookworm now in progress in tropical countries under the auspices of the Rockefeller Foundation. Work on the same lines is also being carried on by Governmental and other agency, so that the number of people now being treated for hookworm disease (ancylostomiasis) probably runs into millions, and they still represent only a fraction of the victims needing treatment, 75 per cent. or more of the native population in many tropical countries being frequently infested with hookworm. Everyone engaged in this work recognises that the best method of dealing with the disease is prevention, but this implies the education of natives into cleanly habits and the immediate provision of sanitary appliances on a gigantic scale, and though neither is being neglected, both can only be accomplished slowly.

It is clear that if mass remedial treatment is to be successful, the drugs used must be safe, efficient and cheap, and it is to the credit of the Hookworm Commissions that they spare no pains to secure these three desiderata in the order given.

Two species of hookworm are concerned, *Ancylostomum duodenale* and *Necator americanus*. These parasites infest the duodenum, where they lie firmly attached to the intestinal wall and protected by a copious exudation of mucus.

The worms (*Taenia*, *Ascaris*, *Ancylostomum*, etc.), which are parasitic in man and other animals, are comparatively highly developed organisms, and as such should be susceptible to attack by drugs in various ways: but it seems to be true that, with the exception of the mixture of alkaloids known commercially as "pelletierine," and possibly santonin, all the anthelmintics in use act by paralysing, more or less completely, the external musculature of the parasites. Several of the text-books on pharmacology and materia medica state that there is, "pelletierine" again being an exception, nothing specific about the action of anthelmintics on worms, that the substances so used are toxic to both parasite and host, and that the host escapes damage from the drugs only because the latter are not readily absorbed. The case does not seem to be quite so simple as this, since there are numerous substances which fulfil these conditions and yet the number of effective anthelmintics is small. In hookworm disease the drugs have to be given in comparatively large doses to secure a local concen-

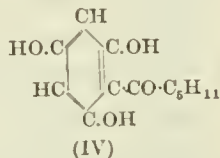
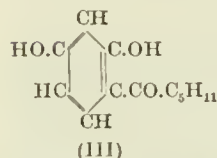
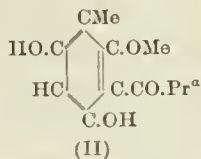
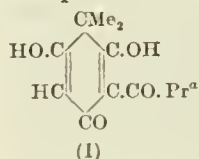
tration sufficient to render the parasites harmless and the amount of drug absorbed is often considerable, although the technique of administration is constantly being improved to avoid this secondary action. It is also difficult to explain on this view why santonin should be active against round worm (*Ascaris*) and inactive against tapeworm (*Taenia*), the reverse being true as regards filicic acid and its allies (extract of male fern), though both are believed to be effective in virtue of their action on the external musculature.

Perusal of the voluminous medical literature on the treatment of hookworm disease shows that a great variety of drugs has been used in practice, including extract of male fern, quassia decoction, a mixture of chloroform with eucalyptus oil, and in certain parts of South America the latex of two species of figs, called higueron or higuerote. All these drugs still have their advocates, but in the organised campaigns against hookworm, the drugs used are β -naphthol, thymol and chenopodium oil, which are named in ascending order of importance. Many efforts have been made to extend this range of drugs, but the only addition that need be referred to is carbon tetrachloride, with which promising results have been obtained recently in Fiji by Hall, and have been confirmed by Nicholls and Hampton in Ceylon and by McVail in India. Carbon tetrachloride is said by Joachimoglu to be 50 per cent. more powerful as a general anæsthetic than chloroform and it is probably this greater activity which makes it more effective than chloroform since Caius and Mhaskar have shown that the latter merely acts on the worms as an anæsthetic and in their view is not a true anthelmintic. The soporific action of carbon tetrachloride on hookworm patients has been noted by McVail in India.

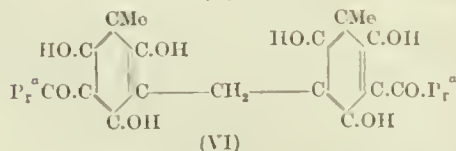
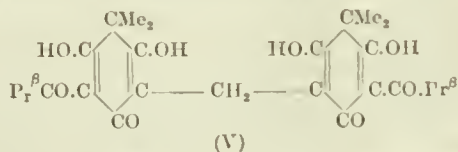
β -Naphthol and thymol are both phenols, and most of the recent work on possible new anthelmintics has been devoted to the study of phenols and especially derivatives of phloroglucinol and resorcinol, following a suggestion made by Fränkel that the active constituents of a number of well-known anthelmintics contain butyric or isobutyric acid residues, with or without phloroglucinol, e.g., filicic acid derived from *Filix mas* and other ferns, rottlerin from kamala, kosotoxin from couso flowers, and ascaridole from chenopodium oil. The examples are not very impressive since filicic acid and its allies are at best uncertain in their action, kamala and couso flowers are now but little used, and ascaridole, though like other terpene derivatives it yields isobutyric acid on oxidation does not contain, strictly speaking, an isobutyric acid residue.

Following Fränkel's suggestion, Karrer and his co-workers have prepared an extensive series of condensation products of aliphatic acids with phloroglucinol and resorcinol analogous to filicic acid (Formula I) and aspidinol (Formula

II) which may be regarded as the nuclear units on which the complex and more active constituents of *Filix mas* and other ferns are built up.



Of these synthetic compounds Karrer has stated recently that the *isohexoyl* derivatives of either resorcinol (resoisohexophenone: Formula III) or phloroglucinol (phloroisohexophenone: Formula IV) are the most promising, and that the *isoacyl* residue appears to confer greater activity than the normal acyl residue, phlorisobutyrophenone being twice as active as phlorobutyrophenone. The naturally-occurring fern compounds become more active with increasing complexity, albaspidin (Formula V) being more active than filixic acid (Formula I) and less active than filixic acid, which is represented by Boehm as containing three rings. The synthetic compounds on the contrary become less active with increasing complexity: thus methylphlorobutyrophenone condenses with formaldehyde in presence of alkali to form 2 : 4 : 6 : 2' : 4' : 6'-hexahydroxy-5 : 5'-dibutyro-3 : 3'-dimethyldiphenylmethane (Formula VI) which should have an activity similar to that of albaspidin, but is in fact less active than the starting material.

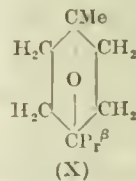
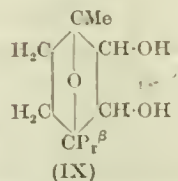
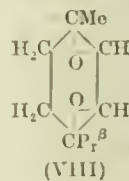
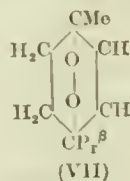


It is probable that the simple mono-, di-, and tri-hydric phenols are all capable of yielding anthelmintics of practical value in proportion as their solubility and toxicity are modified by the nuclear substitution of either alkyl or acyl groups. Phenol itself is used as a remedy for thread worms, but is too irritant for general use and that also applies to its methyl, ethyl, propyl, and butyl homologues, but thymol (methylisopropyl phenol), which is solid at ordinary temperatures and sparingly soluble in water, is a valuable anthelmintic, which is

not toxic to the host even in large doses, provided that it is given in the absence of oils or other substances in which it is soluble and which would increase its rate of absorption by the intestinal walls. Its isomeride, carvacrol, as Darling has shown, is also a valuable anthelmintic for hookworm, but being liquid it spreads and penetrates better than thymol, and is therefore too irritant for use.

Attempts have also been made to lower the toxicity of alkylphenols by converting them into non-irritant esters, such as carbonates, carbamates and *N*-dimethylcarbamates. One of these, thymol carbonate, is stated to have given good results in the outbreak of hookworm disease which occurred during the boring of the St. Gothard Tunnel, but recent trials by Dr. Wilson G. Smillie in Brazil (*private communication*) and by Caius and Mhaskar in India show that the drug is of little value. Another of these preparations, *p*-benzylphenylcarbamate, has been reported on favourably by Koslowsky as a remedy for oxyurids (thread worms). Alkyl ethers of the phenols have been shown to be inactive.

The other known effective remedy against hookworm, chenopodium oil, has been re-examined recently in these laboratories and its constituents isolated and tried in field operations in Brazil by Dr. Smillie as part of a general investigation of possible new remedies for hookworm disease. The clinical results, which are not yet published, show that the sole constituent of the oil which is active against hookworms, is the organic peroxide, ascaridole (Formula VII), and that the variation found by different observers in the action of chenopodium oil is due largely to the varying quantities of this somewhat unstable component in the commercial oil. On heating, ascaridole passes into the isomeride, ascaridole glycol anhydride (Formula VIII), and this on hydration yields a mixture of α - and β -ascaridole glycols (Formula IX) which in turn can be converted into thymol and carvacrol. The



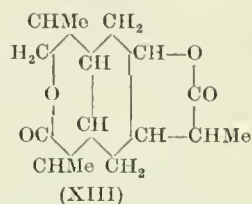
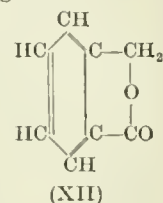
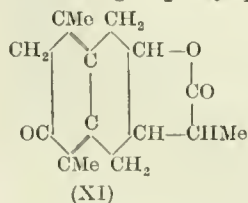
three intermediate products, which may and do occur in carelessly distilled oil, are all inactive against hookworm so that this series of changes begins with an active substance (ascaridole),

passes through three that are inactive and ends with an active compound (thymol). It is interesting in this connexion to mention that cineole (Formula X), which has had some vogue in the treatment of hookworm but has been found by Smillie and by Cairns and Bhaskar to have but little action, is fairly near to ascaridole glycol in constitution, but the latter differs from cineole in containing two secondary alcohol groups and, so far as they have been tried, secondary and tertiary aromatic alcohols have proved useless against hookworm in man.

Ancylostomiasis is in the main a tropical disease, and though it is not unknown in temperate regions, the parasitic worms usually prevalent in Northern Europe, viz., *Ascaris*, *Taenia* and *Oxyuris*, are much less dangerous and receive less attention. Against *Taenia* (tape worm) the drugs most commonly used are male-fern extract, the constituents of which have been discussed already, and "pelletierine" tannate; the latter is not the simple substance its name implies, but is the precipitate formed by the addition of tannin to an extract of pomegranate bark and so contains all the alkaloids known to occur in the bark of which two—pelletierine and isopelletierine—probably form the most active constituents. "Pelletierine," according to von Schröder, is a specific poison for *Taenia* spp.; thus *Taenia serrata*, which infests the intestinal canal of the cat, will live for several days in a warm (37° C.) faintly alkaline solution of sodium chloride, but is killed in 5 to 10 minutes if 1 part in 10,000 of "pelletierine" is added, whilst the round worm (*Ascaris mystax*) is only killed in much stronger concentration of the alkaloid.

Of the drugs used against round worm (*Ascaris* spp.), the most important is santonin. Chenopodium oil is as good or better, and its use for this purpose is common in the United States, and may extend to other countries if the present scarcity of santonin continues. Santonin, as every reader of this *Journal* is no doubt now aware, is at present only obtained from one source—Soviet Russia—being made in a factory in Tashkent from santonica flowers (wormseed) collected locally. Greenish, Simonsen and Goodson have shown independently that it is also present in *Artemisia brevifolia*, found in India. According to Lautenschläger, and in confirmation of observations by Trendelenburg, the activity of santonin is associated with the lactone ring (Formula XI), the sodium salt of the corresponding acid being inactive, an observation which is difficult to reconcile with the existing use of sodium and other salts of santoninic acid as anthelmintics, though it is true that the sodium salt is no longer largely employed owing to its toxicity. These observations appear to be based solely on the results of experiments in the application of the drugs to worm muscle, and they need confirmation by clinical trials. If confirmed they will be of

considerable practical importance since Lautenschläger found that whilst open-chain lactones have no action on worm muscle, such action is not confined to lactone-groups in association with dimethylnaphthalene, as in santonin, but is also shown by phthalide (Formula XII), and its dimethoxy derivative (meeonin) and can be increased by the replacement of one of the methylene hydrogen atoms by an alkyl group or diminished by similar substitution of an aromatic group, e.g. phloroglucinol.



It is interesting to note that the introduction of a second lactone-group into the santonin molecule, as in Wedekind's α -tetrahydro-santonilide (Formula XIII), reduces the anthelmintic action.

Wellecome Chemical Research Laboratories,
September 20, 1922.

THE PRESENT POSITION OF FAT-HARDENING

IN a recent issue of the *Zeitschrift für Angewandte Chemie* (1922, pp. 437-440), Dr.

W. Normann, one of the earliest authorities on the subject, discusses in detail certain technical, scientific and economic aspects of the fat-hardening industry. In the summary of the article which follows only brief references are made to those topics which have been treated recently in these columns (cf. J., 1922, 384 R, 392 R, 415 R).

The pivot upon which the whole art of fat-hardening turns is the catalyst, which nowadays is almost always the metal nickel. The noble metals that were used to a limited extent in the past have been abandoned owing to their prohibitive cost. Neither cobalt nor copper is employed alone; the use of mixtures of them with nickel has been proposed, but whether they have been utilised on a manufacturing scale is unknown to the author.

The method of preparing the catalyst has become practically a standard procedure, viz., the precipitation or decomposition of an easily decomposed nickel compound upon some inert material as carrier. Generally the carbonate is precipitated upon kieselguhr but sometimes gaseous nickel

carbonyl is either decomposed upon a carrier or directly in the oil. Usually the catalyst is reduced in the dry state and then immersed in the oil, precautions being taken to prevent it coming in contact with air; but a class of compounds that has won much popularity includes the carbonate, formate and oleate of nickel, which can be added directly to the oil and there reduced with hydrogen at a temperature slightly above that commonly employed for hydrogenation. In this process the surrounding oil prevents the sintering of the metallic particles, consequently the nickel is obtained in an almost colloidal condition, the oil then having the appearance of ink. Whilst this method has the advantage of permitting the reduction and hydrogenation to be performed in one vessel, this gain is counterbalanced to some extent by the difficulties experienced in filtering the finished product owing to the extremely finely-divided state of the catalyst; but this can be mitigated somewhat by the addition of a carrier.

A process of American origin, based, however, on the researches of Prof. Frerichs, is the use of block nickel, that metal being obtained in very fine subdivision by grinding or milling it under oil or water. This catalyst works far better than might be expected. Moreover, very little care need be exercised in its preparation, and when spent, it is recovered in a very simple manner; after filtration it is re-melted, whereby the organic impurities are destroyed, and then cast and re-milled again to make it ready for further use.

Generally speaking, the methods of working employed in fat-hardening resemble very closely those used in the early days. Mechanical appliances have been introduced for the violent agitation and mixing of the hydrogen, oil and catalyst, but for the most part these are superfluous, for with a good oil the reaction proceeds quite smoothly without such extraneous aid. It must be borne in mind that the reaction is exothermic, consequently, to avoid overheating of the oil, the hydrogenation should not proceed at too great a pace.

The old controversy as to whether the nickel functions in the elemental state or as a sub-oxide has not yet been settled satisfactorily. That it is probably in the metallic form may be deduced from the mode of preparation from block nickel.

The catalytic "poisons" most likely to occur in the nickel salts used as starting material are lead, zinc, and sulphur. The halogens have been proved to be harmless; in fact, nickel has been employed as catalyst in reactions involving the substitution of halogens by hydrogen in organic compounds. Carbon monoxide, the most likely impurity in hydrogen made from water-gas, does not "kill" the catalyst, but merely renders it dormant, Normann having found that nickel inactivated by carbon monoxide can be revived by treatment with pure hydrogen. Of the "poisons" in the oil itself, some may be removed mechanically by filtration through fuller's earth, and others are converted into harmless substances by raising the temperature of hydrogenation to 230°–250° C. Many patents have been granted for the preparation of catalysts which are said to be highly resistant to "poisons," but it is probable that all forms and kinds of catalysts are equally susceptible to them.

Of particular interest is the work of Rosenmund and Zetsche, who found that when certain sub-

stances were added to the catalyst the reaction did not proceed to completion, as might be expected, but came to a definite halt at some intermediate stage. Their researches so far have not been extended to fat-hardening, where the possibility of making a catalytic mixture capable, say, of reducing linolenic and linolic acids to oleic acid might prove of practical value, as, for example, in the manufacture of the semi-solid fats used in cooking. According to Moore, at a proportionately higher temperature the remaining double bonds of an unsaturated acid are more easily reduced than the 9–10 bond in oleic acid; but Moore's observations are not sufficiently satisfactory to support this statement. During hydrogenation there are formed iso-oleic, elaidic and other hitherto unknown isomers of oleic acid that are not present in the original oil. This phenomenon cannot well be due to the wandering of the double bond, as is known to happen in the Varrentrapp method of fusing oleic acid with alkali, rather is it to be explained by the assumption that in hydrogenation no selective action is shown towards any of the two or more ethylenic bonds that may exist in a molecule, and that any double bond may be reduced as it comes into fortuitous and simultaneous contact with a particle of catalyst and hydrogen. In this manner, it will be seen that linolenic acid can give rise to three linolic and three oleic acids.

The formation of these different isomers is to a large degree rendered explicable by the idea outlined above, but another possibility to be entertained, though perhaps happening to a smaller extent, is that of dehydrogenation, which can be effected catalytically by nickel under certain conditions. Normann points out that often towards the end of the hardening the iodine value of the fat rises instead of falling to zero. Dehydrogenation of oils has, in fact, formed the subject matter of an American patent granted to Levey (U.S. Pat. 1,144,589), who claims that by treating oils at 220°–250° C. with a current of gas in the presence of a nickel catalyst he is able to convert a non-drying oil into one having a higher iodine value and with drying properties to correspond. Different gases may be used, even hydrogen, but best results are obtained with carbon monoxide. Oils with high iodine values but with inferior drying properties can be converted into good drying oils by a preliminary partial hydrogenation followed by this dehydrogenation process, for it is maintained that the hydrogen atoms split off are not the same as those primarily added.

In view of our very great ignorance of the colloidal state in non-electrolytes the following observations and inference of the author are of interest. As explained above, when a catalyst is prepared directly in the oil an inky-black liquid is obtained which is very difficult to filter. However, after partial or complete hydrogenation of the oil the nickel tends to coagulate and become flocculent and consequently is easily filterable. This was first remarked by Erdmann. Now when this nickel, which may be either settled or filtered off, is added to fresh oil it disperses in that medium and an inky-black fluid difficult to filter is again obtained. Mixed with petroleum ether this same nickel remains flocculent and can be readily filtered, but when mixed with benzene the nickel gives a brownish-black liquid which is unfilterable or very diffi-

cult to filter. Normann suggests that the formation of this apparently colloidal solution of nickel is associated with the double bonds contained in the solvent.

Owing to the paucity of published data and statistics relating to the fat-hardening industry and the natural reluctance of individual firms to disclose information concerning their production, it is very difficult to obtain a true measure of the present position of the economic development of this comparatively new industry. During the last fifteen years the industry has become firmly established and works for fat-hardening are now to be found in all parts of the world. The first plant to be erected was that at Crosfield's in 1907, which had an output of 2 tons per day. Although statements have been made to the contrary, the second plant to be operated was at the works of Leprince and Siveke in Herford in 1908, whilst the third was erected by Wilbuschewitsch at Nijni-Novgorod in 1910.

In 1914 there probably existed altogether 21 works for fat-hardening, 18 of which were in Europe, having an annual output of approximately 230,000 tons of hardened oil. At the present day there are about 60 factories in Europe alone. Of this number 11 at least are in Germany, but more than half of these are not controlled by German capital; this figure is probably underestimated, for it is extremely difficult to ascertain the precise number, a remark which also applies to the following information concerning other countries. The number of works at the present day in England is given as 3, in France 5, in Holland 5—6, in Belgium 2, in Denmark 3, in Norway 4, in Sweden 4, in Russia 2, in Bohemia 2, and in Hungary 5, only one of which is known to be working. In other European countries the number of works averages about one in each; in countries outside Europe, there are 14—15 works in the United States, 8 in Japan, 1 in Manchuria and 1 in Egypt. Owing to trade conditions it is more than probable that at the present time many of these works are either idle or not producing to their full capacity.

Practically all oils met with in commerce are used as material for hardening. The suitability and application of hardened fat in the manufacture of soap is now so well known that lengthy reference to it is unnecessary; at first a great deal of prejudice had to be overcome before it was employed. Of much more interest is the use of hardened fats for edible purposes, an application that quickly resulted after it had been established that they were not only digestible and wholesome but also completely assimilated by the body. In Germany most of the edible hardened fat is manufactured into margarine; in America its use for the preparation of lard substitutes seems to be preferred.

The above-mentioned 14—15 works in the United States have a total productive capacity of 142,000 tons per annum, but during the last few years their output has been little more than half this quantity, as is shown by the following annual returns: in 1919, 54,635 t.; in 1920, 81,891 t.; and in 1921, 93,071 tons. The oil hardened in these works was of vegetable origin, for fish oils are apparently not treated in the United States, though the possibility that this source of raw material will be utilised in the near future seems very likely. This hardened fat was used mainly for edible purposes, very little entering into soap manufacture,

because it cannot compete against the considerably cheaper animal fats. In this connexion Normann quotes a reliable communication received from America to the effect that the fat-hardening industry in that country is in a parlous condition because the margin between the price of liquid oils and that of natural hard fats is less than the working costs of hardening.

The following figures give the amounts of hardened fat absorbed by the margarine industry in Germany during the war, when food restrictions were in force; in the year 1915, 4945 t.; in 1916, 12,978 t.; in 1917, 7714 t.; in 1918, 15,217 t.; and in 1919, 30,421 tons. The part played by the fat-hardening industry in Germany during the war cannot be too highly praised, for, supplied with the very worst of oils, such as whale, poor linseed, and very bad rape-seed oils, it had to convert these into tasteless and odourless fats, the shortage of other oils and fats suitable for edible purposes being very acute. Hardened whale oil, however, was in use before the war as an edible fat; in 1914 Denmark consumed 3000 tons of it in the production of margarine, for which purpose it is quite suitable. So enormous has been the demand for whale oil to supply the needs of the fat-hardening industry that the whale and similar sea animals have practically been exterminated in the northern hemisphere, and unless international restrictions are made to prevent it, a similar state of affairs appears imminent in the southern waters whither the whaling industry has migrated. A gradual diminution in the supply of this comparatively cheap oil may therefore be expected in the future, but this will hardly influence the industry of fat-hardening to any great extent for an abundant source of raw material is to be found in the vegetable oils.

NEWS FROM THE SECTIONS

NOTTINGHAM

The first meeting of the session was held on October 18, when the chairman, Mr. S. F. Burford, Public Analyst of Leicester, gave his inaugural address on "Industrial Chemistry, its Importance and Progress."

The Society of Chemical Industry, founded on broad and catholic lines, has been organised to pool the wealth of chemical knowledge. It is to our younger chemists, coming into this heritage, that we look for further developments. Many examples show how greatly the chemist has added to the sum of human happiness and security. This is partly known to the man-in-the-street, who makes many demands on his power and supposed omniscience. The commercial man, whilst appreciating the value of insurance against fire and trade risks, demands of the chemist immediate returns, and expects by placing a penny in the slot to make fortunes, like a broker, from the power of transmutation. In reality all exploration is costly. The disinterested worker places freely at the disposal of his fellow-men the results of laborious researches. Trading corporations must not be content to make their profits out of such results, but on their own account should subsidise research for the public, as well as for their own

benefit. Examples were given of such enlightened action. On the other hand, civic corporations, in particular, have not yet risen to their responsibilities in the disposal of their waste products by financing schemes of investigation as a matter of public duty, and of great contingent benefit and profit.

MONTREAL

The first meeting of the Session 1922-1923 was held in the Queen's Hotel, Montreal, on October 16. The chairman, Dr. A. R. M. McLean, presided, and the speaker of the evening was the ex-President, Dr. R. F. Ruttan.

Dr. Ruttan recounted his experiences in Great Britain and France on the occasion of his visit for the Annual Meeting. He spoke of the hospitality so lavishly extended to him as a compliment to Canadian chemists rather than a personal one, and many interesting souvenirs of that meeting were passed round to the members. Dr. Ruttan also spoke of the status of the chemical engineer in the Old Country and the efforts that were being made to secure men trained to be good chemists and good engineers but not specialists, introducing the analogy of the general medical practitioner. Referring to the chemist in Canada he said: "No class in the community is more interested in such national questions as technical education, utilisation of waste products, controlling and directing the application of scientific methods to the development of industries and of the resources of the country. Members of no profession are so well qualified as are chemists to direct legislation along effective and economic lines. We chemists, as a body, are too much inclined to shut ourselves up in our own interests, whether academic or commercial. It seems time for the chemist to take greater cognisance of public affairs and to assume an active part therein."

In dealing with the need of closer union between not only academic and industrial chemists, but also scientific organisations generally in Montreal, Dr. Ruttan urged the formation of a Science Club. Such a club in Montreal would bring together the Natural History Society, the Montreal Chirurgical Society, mining, engineering, and other organisations which are now housed separately. In order to bridge the gap between academic and industrial chemists a fifth year should be added to the university course in which the student would, under direction and tuition, do work on industrial processes. He also spoke of the need of inducing the Legislature to create an advisory committee of chemists to act for the Government in connexion with the Customs and other departments, as he found there was no one who could advise the Government departments on questions that are now, more than ever before, arising in connexion with imports and the use of chemicals. The Government should be compelled to subsidise the exhibits of resources, production, and those showing the development of new chemical industries at the 1924 Imperial Exhibition, to be held in England to illustrate the natural resources of different parts of the Empire.

After Dr. Ruttan's address Mr. A. Neighorn moved a resolution, which was seconded by Mr. H. W. Matheson and adopted unanimously, that a prize of \$50 be offered to a third-year McGill

student for the best essay on his practical experience of chemistry as applied to industry.

Mr. G. E. Sanders, formerly of the Department of Agriculture, in charge of research on insecticides, spoke briefly on the development and spread of insects destructive to crops and trees.

GLASGOW

The new session was opened by a meeting held on October 20 in the Institute of Engineers and Shipbuilders, Glasgow. Mr. W. E. Moodie, the new chairman of the section, presided and introduced Dr. H. Hepworth, who gave a most interesting account of "The Syntheses of the Tannins."

Following a historical introduction, the lecturer reviewed the work of Emil Fischer and traced the various steps in the synthesis of pentadigalloyl-glucose, which has a molecular weight of 1700 and a rotatory power resembling that of natural gallotannin. It was emphasised that much of Fischer's success was due to the control which he was able to effect upon the hydroxyl-groups during a condensation, a control made possible by treating the hydroxy-compound with chloroformic ester prior to condensation. An example of such control was afforded by the synthesis of a depside, a substance able to coagulate gelatin and formed by the condensation of a hydroxyl-group of one molecule with a carboxyl-group of another. Such a substance was digallic acid formed by the condensation of two molecules of gallic acid. Reference was made to the synthetic compound prepared by Fischer shortly before his death in 1919, which had a molecular weight of 4021 and a molecule containing not fewer than 220 carbon atoms, and which had been prepared with the aid of phenylhydrazine, Fischer's "guiding star." This substance was the condensation product of tribenzoyldigalloyl chloride with the osazone of maltose and *p*-iodophenylhydrazine. The work of Nierenstein was then discussed and it was shown that Fischer's formula for gallotannin could not be upheld and correlated with the production of tetramethylglucose, as obtained by Nierenstein in the hydrolysis of purified gallotannin. In conclusion, it was stated that nothing was known regarding the constitution of the other natural tannins, except that they were not all glucosides.

EDINBURGH AND EAST OF SCOTLAND

Dr. H. E. Watt presided at the first ordinary meeting of the present session, held on October 24 in the Hall of the Pharmaceutical Society, Edinburgh. The Secretary announced that Mr. J. Henry, of Leith, had been approved by the Committee for admission as an Associate, and on the motion of Mr. J. Rutherford Hill this was approved.

The chairman then delivered his opening address entitled "Some Thoughts on the Training and Career of the Industrial Chemist." The importance of a university or college training for industrial chemists was emphasised. The training in pure chemistry should be as wide as possible, specialisation in any particular branch being left until the completion of the university course qualifying for the degree or the Associateship of the Institute of Chemistry. Additional subjects of study should include mathematics and physics, and, if possible, biology. Dr. Watt also discussed the

question of looking for employment and gave some sound advice to prospective industrial chemists on the bearing of candidates at interviews. The career of the chemist was then outlined with many light and humorous touches and much instructive criticism and advice. A good discussion followed in which Mr. W. A. Williams, Dr. Lauder, Messrs. Rutherford Hill, Baxter, Cottrell, Merson, Ludlam, and Williamson took part.

LIVERPOOL

On October 27, in the Muspratt Lecture Theatre of Liverpool University, Mr. W. M. Inman read a paper on "Developments in the Use of Bleaching Agents for Textiles and Paper Pulp," of which an abstract is given below. Dr. G. C. Clayton, chairman of the Section, presided over a good attendance.

Methods of bleaching did not change materially from ancient times until the middle of the eighteenth century, Scheele's discovery of chlorine initiating the first real development. Bleaching by chlorine gas was, however, not very successful, and it was left to Charles Tennant to develop the application of Scheele's discovery. In 1798 Tennant prepared "bleach liquor" by passing chlorine into milk of lime, and subsequently solid bleaching powder, which obviated the difficulty of transport. Much attention was given to making a bleaching powder containing more than 35 per cent. of available chlorine, but the solid sodium and calcium hypochlorites were a failure owing to difficult and expensive methods of manufacture. In recent years liquid chlorine has been much used. In future it is probable that the method of 1798 (*cf. s.*) will return to favour, the hypochlorite being utilised on the spot. This method is used in many paper mills in North America; the chlorine, from tank wagons containing the liquid element, is passed into stoneware towers down which milk of lime is flowing. In this way the bleach-mixing plant is dispensed with and there is less residual sludge. A comparatively small plant can furnish a large output, and the process is economical. It is possible that the old-fashioned "gas bleach" for the resolution of lignified fibres may again come into prominence, especially if the gas be derived from liquid chlorine. In America the new paper mills use a liquid-bleach plant, but it is quite feasible to make bleach liquor from milk of lime and chlorine in the common type of bleach-mixer that is used in British paper mills. All that is necessary is to provide dip pipes through which the chlorine can be introduced. The mixer is filled with milk of lime and agitated at a fairly high speed. The chlorine is absorbed slowly at first but more readily later, and a bleach liquor of any convenient strength can be made. Alternatively, it is suggested to chlorinate the free lime which is present in all bleaching powders during the operation of mixing it with water to produce bleach liquor. The liquid chlorine is contained in 70-lb. cylinders and the content of one cylinder suffices to chlorinate 6 cwt. of bleaching powder. Advantages of this process are: reduction in amount of sludge; more rapid working due to quicker sedimentation; less bleaching powder is used and less irritant dust gets into the air. This process has been used in Germany for many years; it was first tried here in 1919. In the future the user will make his own bleaching agent from an alkaline base and liquid chlorine.

BRISTOL

The second meeting of the Session was held in the University on November 2, when Mr. C. J. Waterfall presided over an excellent gathering numbering 60. Among the visitors present were members of the Bristol and District Boot and Shoe Trade Managers' and Foremen's Association. Mr. Stanley Hirst, of Messrs. Cox and Co.'s Successors, read a paper entitled "From Hido to Leather," and illustrated his remarks by showing numerous specimens and samples of tanning materials, leather made by various processes, and sources of damage to hides. An excellent discussion followed, and a vote of thanks to Mr. Hirst was proposed by Mr. M. W. Jones (vice-chairman) and seconded by Mr. Arthur Marsden. The president of the Boot and Shoe Trade Managers' and Foremen's Association expressed thanks on behalf of its members for the invitation to be present. In conjunction with the paper, arrangements were made for members to visit the tannery of Messrs. Cox and Co.'s Successors on November 8.

MANCHESTER

The meeting held on November 3, when the attendance was over two hundred, was the second of the intended series of annual joint meetings arranged by the Manchester Sections of the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colourists, and the Manchester Literary and Philosophical Society. Dr. E. F. Arden presided at the outset, and explained that as the arrangements for the meeting had been made by the last-named society, and would have been held in its rooms if they had been large enough, Prof. W. L. Bragg had been asked to preside. Prof. Bragg then took the chair and introduced Dr. F. W. Aston, who gave an address on isotopes, of which the following is the official summary:

Dalton's atomic theory postulated that atoms of the same element are equal in weight. Beyond mere speculation the first attack on the validity of this wholly unproved hypothesis was made about 1910, when Soddy put forward his theory of isotopes and predicted the existence of varieties of lead having different atomic weights, a prediction amply verified later. The same possibility was suggested in the case of the non-radioactive elements by the positive-ray analysis of neon. By this analysis one compares the weights of individual atoms, and this can now be done with an accuracy of one part in a thousand by means of the mass-spectrograph. This instrument gives a focussed spectrum depending only on the weights of the particles forming the positive rays, and as these are charged atoms and molecules, their weights can be directly compared. It is found that many, probably the majority, of the elements consist of mixtures of isotopes. Thus chlorine (atomic weight 35.46) consists of two isotopes of atomic weights 35 and 37 respectively. Some of the heavier elements are exceedingly complex, xenon having no less than nine constituent isotopes. By far the most important result is that the atoms of all elements except hydrogen have integral weights when expressed on the oxygen scale to a considerable degree of accuracy. This "whole number" rule enables sweeping simplifications to be made in our

ideas of mass. All atoms may now be considered simply as different aggregations of primordial atoms. The latter are of two kinds, positive and negative, protons and electrons, the particles of electricity itself. The fact that the elements of fractional atomic weight are mixtures of isotopes of whole-number atomic weight explains at once anomalies in order, such as the atomic weights of argon and potassium. On Rutherford's nucleus-atom theory, isotopes are elements whose atoms have the same net positive charge on their nuclei (Moseley's atomic number) but different numbers of protons and electrons in these nuclei and therefore different weights. Isotopes have practically identical chemical and optical properties. Their separation is a matter of extreme difficulty and only the minutest changes of atomic weight have been experimentally detected so far. The weight of the hydrogen atom is found to be greater than unity; this is of great importance for if it were possible to transmute hydrogen into any other element prodigious quantities of energy would be liberated. This transmutation is probably going on continuously in the sun and other stars.

BIRMINGHAM

Dr. E. B. Maxted, chairman of the Section, presided at the dinner held in the Queen's Hotel on November 4, when the guests included Dr. E. F. Armstrong and Mr. and Mrs. F. R. O'Shaughnessy. To mark the retirement of Mr. O'Shaughnessy after 17 years' service as hon. secretary of the Section, the President, on behalf of the members, handed him a laboratory microscope with complete accessories and a scroll testifying to the esteem in which he was held, and Mrs. O'Shaughnessy was presented with a gift of jewelry.

In proposing the health of Mr. and Mrs. O'Shaughnessy, Mr. H. Silvester referred to the ability and tact with which the late hon. secretary had performed his duties and recalled that although the Section was formed shortly after the foundation of the Society in 1881, it remained in existence only a short time. Sir W. Tilden then initiated the Birmingham Chemical and Metallurgical Club, but as there were no facilities for publishing papers read at the meetings, the Birmingham Section was reformed, largely through the enterprise of Mr. O'Shaughnessy. During his period of office the late hon. secretary organised annual meetings of the Society in 1907 and 1917, and 157 papers had been read before the Section. Dr. Armstrong observed that not only had Mr. O'Shaughnessy's work enriched chemical science but it was for the public benefit, and he hoped that the microscope would enable him to amplify it; on behalf of the Society he expressed deep indebtedness to the hon. secretaries of the Sections for their loyal service.

In returning thanks for the gifts Mr. O'Shaughnessy observed that the tendency had been to enhance the technical side of the Society's activities and pleaded for more attention to the social side.

The toast of the Society was proposed by Mr. E. R. C. Marks, chairman of the Midland Section of the Institution of Mechanical Engineers, who pleaded for closer co-operation between the mechanical engineer and the industrial chemist. Replying to the toast, Dr. Armstrong stated that this year the Society had a very definite policy, viz.,

to raise the position of the chemical profession to that of the legal, medical and engineering professions. Within the next few years chemists would have to decide whether they would rehabilitate their profession or be content to remain in the wilderness. Practice and research were necessary, but the importance of observing professional etiquette, and of cultivating a broad outlook and ideals, were not yet sufficiently recognised. Prof. A. R. Ling proposed the toast of "The Guests" and Mr. J. G. Smont, president of the Birmingham Metallurgical Society, who replied, remarked on the harmonious relations that had existed between that Society and the Section, and observed that if, in the past, metallurgy had developed mainly on the engineering side, metallurgists were now returning more to basic principles—to chemistry. Dr. E. B. Maxted, responding to the toast of his health, expressed the hope that the evening would mark the first of a long series of annual dinners. The credit for the success of the arrangements for the dinner was due to Mr. G. King, the new hon. secretary.

MEETINGS OF OTHER SOCIETIES

THE FARADAY SOCIETY

The latest of the series of useful discussions promoted by the Faraday Society was held, in conjunction with the British Cold Storage and Ice Association, on October 16 in the Institution of Electrical Engineers. Papers were received from several distinguished foreigners, Prof. H. K. Onnes and Dr. C. A. Crommelin, of the Cryogenic Laboratory, Leyden, and M. Claude, of Paris, but of these only Dr. Crommelin was able to attend.

"On the Lowest Temperature yet obtained" was the subject of Prof. Onnes's paper, and in it he describes attempts that have been made to prepare solid helium by the boiling of liquid helium under reduced pressure, the latest attempt—made in 1920—being given in detail. The actual pressure on the surface of the helium was 0.012 to 0.014 mm. and the lowest temperature 0.9° Absolute; but no solid helium was obtained.

Dr. C. A. Crommelin described in detail the methods used in the Cryogenic Laboratory in Leyden, and particularly those for liquefying various gases and obtaining any desired temperature below °C. and maintaining it constant within 0.01° C. The advantages of ethyl chloride as a refrigerating agent were discussed by Prof. C. F. Jenkin. The high inflammability of this substance can be counteracted by mixing it with ethyl bromide. Most metals are not corroded by it, but rubber and woods are affected. Moisture must be rigorously excluded from the refrigerating machines, since ice-crystals may be formed which choke the valves.

Dr. Ezer Griffiths and Mr. J. H. Awbery discussed the thermometric lag in cold-storage practice, a subject which they have investigated at the National Physical Laboratory; and the former, in a paper on some materials of low conductivity, described some of the lesser known substances which have been found to be very efficient insulators. Among these are "expanded rubber," or rubber in a highly cellular form, of density 0.06 (ordinary

vulcanised rubber has density 1.5), and Balsa wood from Ecuador, which is extremely light, a cubic foot weighing from 5.7 to 8.6 lb., compared with 45 lb. per cu. ft. for mahogany. This wood has little strength but, unlike cork, it can be worked with ordinary wood-working tools. Other materials described were: fibres of *Kingia Australis*, eel grass, and compressed peat.

Mr. C. R. Darling contributed a short description of a thermo-couple designed for low-temperature work, and a paper of great practical interest on industrial methods of liquefaction and practical applications of low temperatures was read by Mr. S. K. Murray, of the British Oxygen Co., who gave a full account of the Linde and Claude processes, together with some figures of cost. The dis-used barium-oxide process of making oxygen is economically the equal of the air-liquefaction methods, but the oxygen produced by it is less pure. The secret of cheap oxygen is large liquid-air units worked to their full capacity. Ninety-six per cent. of the oxygen sold in this country is used in industry, mainly for metal-cutting. It is doubtful whether it is yet economic to use oxygen for enriching air for blast furnaces (a subject discussed by Mr. Cosmo Johns), or, in conjunction with steam, for the continuous gasification of fuel. The only uses of oxygen in chemical industry, known to the author, are in the manufacture of nitric and acetic acids in Germany. Practically all the oxygen used throughout the world is oxygen stored in cylinders; about 300 million cu. ft. per annum is distributed in this form in this country, even in the present bad state of trade. In France the output is about the same, in the United States three times and in Germany more than twice as much as in Great Britain.

Monsieur G. Claude's paper on the manufacture of hydrogen from water gas and coke-oven gas described his methods of separation by partial liquefaction. It would appear that the production of hydrogen from water gas has hardly any advantages over other processes, but the author believes that his process is likely to be of great service to the coke-oven industry, owing to its many indirect advantages, e.g., the recovery of benzol and ethylene.

A paper which gave rise to considerable discussion was that by Mr. E. A. Griffiths on the use of liquefied gases in aeronautical work. An efficient all-metal vacuum vessel was described in which either charcoal or silica gel is used as absorbent, and also a modified form of metallic vacuum vessel which permits the rate of vaporisation to be regulated.

SOCIETY OF GLASS TECHNOLOGY

The first meeting of the session was held in York on October 18, Prof. W. E. S. Turner presiding. In a lecture on "Processes and Methods of Medieval Glass Painting," Mr. J. A. Knowles, of York, said that medieval window glass was a potassium-calcium-silicate, and practically all the glass used for painting was imported, supplies for the school of glass-painting at York being derived from Hesse and other Rhenish provinces and for the London school from Lorraine, Burgundy and Normandy; the uncoloured glass used in the north of England was much whiter than that used in the south. The statement that no modern colours

equalled those of old windows was erroneous. With the exception of "ruby" glass, medieval coloured glasses were those most easily produced, and being made from impure native oxides containing other metals, each of which imparted a slight tint to the glass, the colours obtained were not pure but slightly secondary, so that they always harmonised. The glass at York, particularly that of the 11th century, was liable to corrode. There was no cure for pitting and corrosion, which were effects due entirely to bad manufacture, deficiency of silica, excess of alkali, and bad founding. Corrosion was not a sign of age.

A paper on "Modern Developments in the Making of Stained and Painted Glass" was presented by Mr. H. J. Powell, of London, who was unfortunately absent through illness. Decay of the actual substance of mediæval window glass was not inevitable; much Roman glass and window glass of the 12th and 13th centuries were perfectly preserved. Some mediæval glass, however, had become opaque and very friable, and all the observed forms of decay originated in the use of an excess of alkali, which caused the glass to become hygroscopic. Considering the haphazard way glass was made in mediæval times, it was more remarkable that most of it had survived than that a little of it had failed.

Members were given the opportunity of inspecting the Roman glass, etc. in the Yorkshire Museum, the windows of the Minster, and the workshops where glass from the latter was being treated.

SOCIETY OF PUBLIC ANALYSTS

The first meeting of the current session was held on November 1 in the Chemical Society's Rooms, Mr. P. A. Ellis Richards presiding.

In a paper on the "Colorimetric Estimation of Pyrogallol, Gallotannin, and Gallic Acid," Mr. C. A. Mitchell described the use of a ferrous-tartrate reagent which gives a violet coloration with the pyrogallie group, and which is applicable as a quantitative measure of that group in various compounds. Using this method a constitutional formula for gallotannin was deduced which agreed best with that proposed by Nierenstein. In determining gallotannin in presence of gallic acid, both substances are estimated together colorimetrically in terms of gallic acid or pyrogallol, the tannin is precipitated with quinine hydrochloride, and the gallic acid estimated in the filtrate. The difference between the two results, multiplied by a factor, gives the gallotannin. The method has been used to estimate tannin and gallic acid in various natural and commercial products, to follow the course of the enzymic hydrolysis of gallotannin, and so on.

Dr. H. E. Annett and Mr. M. N. Bose described "The Estimation of Narcotine and Papaverine in Opium" by a method which requires the use of only 1 to 2 g. of the drug. On adding sodium acetate to an aqueous opium extract under specified conditions, narcotine and papaverine are precipitated completely and narceine partially. The last-named is removed from the precipitate by washing with water, and the narcotine is purified further and estimated polarimetrically.

"The Estimation of Codeine" was the subject of a paper by Dr. H. E. Annett and Mr. R. R. Sanghi. The codeine is extracted with toluene from

an aqueous alkaline extract of opium, converted into hydrochloride, re-extracted with toluene (any residual codeine being converted into hydrochloride), and weighed as hydrochloride (*cf.* J. 1920, 702 A).

A paper on "The Estimation of Morphine," by Mr. J. R. Nicholls, described a method based on the fact that if 2 volumes of 50 per cent. alcohol is shaken with one of chloroform and allowed to separate, the two layers are approximately equal in volume, the upper containing about one-third of alcohol and the lower consisting of 2 parts of chloroform to 1 of alcohol. If the 50 per cent. alcohol contains morphine liberated by ammonia, about 85 per cent. of the total alkaloid will pass to the lower layer; when this is run off, half a volume of alcohol added (bringing up the strength to 50 per cent), and the whole shaken with 1 volume of chloroform, the second layer contains about 85 per cent. of the remaining morphine. Three extractions remove over 99 per cent. of the base and in practice 4 extractions only are needed to remove more than 0.1 g.

In some "Notes on the Estimation of Potassium by the Perchlorate and Cobaltinitrite Methods," Mr. R. Morris described a modification of a previous method (*cf.* J., 1920, 767 A) to make it applicable to the direct determination of potassium in the presence of certain insoluble phosphates. A method is put forward of precipitating sulphates—which must be removed—with barium chloride, which obviates practically all loss of potassium in the precipitated barium sulphate. Drushel's modification of the cobaltinitrite-permanganate process gives good results, especially for small quantities of potassium; the precipitate should be washed finally with a semi-saturated solution of sodium chloride; the presence of sulphates is immaterial.

SOCIETY OF DYERS AND COLOURISTS

At a meeting of the Manchester Section, held on October 27, Prof. E. Knecht presiding, Messrs. L. G. Radcliffe and W. Gibson presented a paper on "A Hydroxystearic Acid and Some of its Derivatives," which was a continuation of a previous paper on the action of nitric acid on saponifiable oils (*cf.* J., 1920, 305 A).

The authors have prepared a hydroxystearic acid of m.p. 85° C. from an oleic acid by the action of sulphuric acid, as previously described, and from it have obtained, for the first time, the methyl ester in the form of white flakes (m.p. 46° C.), the ethyl ester (m.p. 48.5° C.), and an acetyl derivative (m.p. 32° C.), but they have failed to isolate a benzoyl derivative in a state fit for analysis. A study was made of the interaction of bromostearic acid and silver nitrite with the object of preparing true nitro-compounds of stearic acid, but no such compound was obtained, even when silver nitrate was used. By acting on hydroxystearic acid with nitric acid a yellow crystalline substance (m.p. 82° C.) was obtained from which derivatives were prepared, but the analytical results were not sufficiently concordant to enable a constitutional formula to be deduced. The yellow substance contains no nitrogen and molecular-weight determinations gave contradictory results; but it is possible that its molecular weight may be 291. The esters have been prepared.

INSTITUTE OF CHEMISTRY

The Sections for the Leeds area and Huddersfield were addressed by the Registrar on "The Present Position and Future Prospects of the Institute and of the Profession," on October 23 and 24, respectively. His address, he said, was intended to provide material for debate. He compared the position of the Institute with its position in the past, having regard to the services which it rendered to the community, and compared it also with that of similar bodies. The chartered professional institutions generally had become recognised as part of the machinery of the State; they supplied the hallmark whereby the trained practitioners in any profession could be recognised; they exercised greater influence and received greater recognition from the community than formerly. They existed for public service, but their most valuable work lay in upholding the status of their professions, whilst each individual member reaped the benefit of being acknowledged by his professional body as a whole. The result in the case of the Institute was the establishment of an organisation of nearly 4000 members with a very high standard of professional competency and integrity, an organisation which rendered the country good service and of which every member had good reason to be proud.

In the eye of the public there was still a misunderstanding as to the word "chemist," but he thought progress had been made in the matter; not so much with the man-in-the-street but with the people that count. Chemists were coming into their own title by the natural process of assuming it. They could not take any other.

The position of the profession might be gauged by the extent to which it was employed. After the war and at the end of 1920 only 13 members of the Institute were without employment, and even now, in view of the very large increase in the number of recruits to the profession and the depression in industry, it was remarkable that only 130, or less than 3 per cent. of their members, were seeking employment. Compared with other professions, the training for chemists was as prolonged, the order of intellect required was higher than most, and the services rendered, so far as they could be compared, were as valuable.

In the discussion at Leeds, the chairman, Mr. W. M. Mackey, in opening the debate, referred to Mr. Pilcher's long connexion with the Institute and to the growth of the Institute during that time. It was, he said, a great advantage, particularly to those about to enter the profession, to hear criticism from one who, although not a chemist, had an inside knowledge of the profession.

Mr. F. W. Richardson said that manufacturers and industrialists required educating as to the value of the qualifications conferred by the Institute. He was decidedly pessimistic in regard to the position of trained chemists.

Mr. B. A. Burrell said he was in substantial agreement with Mr. Richardson's views. There was no doubt that the profession of analytical chemistry was overcrowded and one wondered what was to become of the many young chemists who were being turned out by the universities.

Mr. F. W. Branson disagreed with Mr. Richardson's remark that manufacturers in West Yorkshire did not encourage members of the Institute of Chemistry.

Dr. R. B. Forster said he was glad to hear that Mr. Pilcher attached great importance to the word "chemist." He had always held the view that only those who were members of the profession were entitled to be called "chemists." They had made some progress and he felt sure they would ultimately succeed if they persisted. He did not agree with the pessimistic remarks of some of the speakers; it was true trade was bad, but employers were much more enlightened than formerly, and to support his argument he mentioned that out of the 31 students who took their B.Sc. in Colour Chemistry in Leeds University last June, only four were still seeking employment.

Mr. R. Gawler said that the Institute was sometimes described as the Institute of Chemists instead of the Institute of Chemistry. He considered the advancement of science to its true place in the national life a far loftier motive than might be read into the title "Institute of Chemists" by a member of the general public.

Mr. G. Ward, in proposing a vote of thanks to Mr. Pilcher, said that the lecturer had dwelt on many points which gave food for reflection. He did not agree with the deprecatory remarks of some of the speakers. Much of the future of the younger members lay in their own hands.

At Huddersfield, the chairman, Dr. H. H. Hodgson, agreed that the work of the Institute was largely one of patriotism. The chemist was a valuable asset to the State. It was possible that if this country failed to develop its dyestuff industry the textile industry would eventually pass into the hands of the country possessing the strongest dyestuff industry.

Mr. H. W. Moss thought the note of optimism in the Registrar's address very useful at the present time, when a number of qualified and experienced chemists found it difficult to secure employment.

Mr. H. T. Lea put in a plea for a more comprehensive register of chemists to be available in all public libraries.

Mr. G. B. Jones urged the need of chemists on the commercial side of industry, so that customers might get into direct contact with those possessing a broad scientific outlook.

Dr. J. Bruce said that business men must realise that research could be made to pay. Results could not be expected at once. A good understanding between the chemist and the management was essential.

Mr. H. S. Foster deprecated the assumption that chemists are lacking in general culture. He thought that the Institute might usefully issue a pamphlet pointing out that a chemist of sound training without special experience is a better investment than one with special experience but an inferior training.

Mr. S. Robson suggested that chemists should get a place in the management by forcing out the non-technical man, and that this was largely a question of personality.

Dr. A. E. Everest thought the formation of local Sections was an enormous step forward in that it had brought about a more intimate relation between the individual chemist and the Institute.

Dr. L. G. Paul compared the status of the chemist in the works 40 years ago with that of to-day. There had been a vast improvement.

CORRESPONDENCE

PHOTOGRAPHIC SENSITISERS

SIR,—I am sorry that the note on "A Green Photographic Sensitiser" on page 293 R of your issue of July 15 escaped my notice until just recently, as it contains several errors which should not be passed over without comment.

The deficiency of sensitiveness which has longest withstood efforts to remove it is not in the blue and greenish yellow as suggested, but in the blue-green in the neighbourhood of $\lambda=5000$ to 5200μ . This point was certainly recognised by Sir William Pope in the paper in question, which contains the sentence: "It is noteworthy that the failure to sensitise gelatino-bromide plates for a short region in the bluish-green which occurs so frequently with sensitisers for the yellow and red regions of the spectrum, does not occur with the substance now described." The existence of this blue-green gap is, however, not such a drawback as is suggested, since it enables the use of at least a small amount of light in the manufacture and treatment of panchromatic plates which would otherwise have to be not only handled, but manufactured, in complete darkness.

Secondly, the suggestion that this is the first green sensitiser of which the constitution has been published, shows very slight acquaintance even with the work of Sir William Pope himself. In a paper published in the *Photographic Journal* in May, 1920, by Sir William Pope and Dr. Mills, at least four dyes are described which confer sensitiveness to the green and yellow green, and one of these has been in regular use for the manufacture of panchromatic plates for a considerable time.

The constitution of some of these dyes was discussed, if not satisfactorily settled, as long ago as 1905 by König, and later by Shepherd (*Photogr. J.*, 1908, 300—318).—I am, Sir, etc.,

Ilford, Oct. 24, 1922.

B. V. STORR.

In the interests of strict accuracy, thanks are due to Mr. B. V. Storr for his courteous correction of the unfortunate slip which was made in the insertion of the words "yellowish-green." The whole purpose of the note was, firstly, to show why our very busy eminent scientists thought it worth while to devote their talents to the preparation of dyes which confer colour sensitiveness upon the ordinary photographic emulsion; and, secondly, to intimate to the readers of the *Review* that, whilst the particular green sensitiser under consideration had in all probability been prepared at an earlier date by Dr. König, of Höchst am Main, to Sir William J. Pope must be accorded the honour of publication of the details concerning its method of manufacture and constitution. As Sir William Pope himself states, in the communication to the Chemical Society: "This substance . . . the most powerful sensitiser for green light yet known for gelatino-silver bromide photographic plates. The new sensitiser is the simplest member of a novel series of compounds," the writer of the article may perhaps be excused the offence of having used the sentence beginning: "This is the first green sensitiser of which the constitution has been published"—the word "green" being used by the writer in exactly the same sense as that accorded to it by Sir William J. Pope.

THE WRITER OF THE NOTE.

STREATFEILD MEMORIAL LECTURE

THE METALLURGICAL CHEMIST

C. H. DESCH

On November 2, in the Finsbury Technical College, London, the Streatfeild Memorial Lecture was delivered by Prof. Cecil H. Desch, professor of metallurgy in the University of Sheffield, to whom the Streatfeild Medal was presented by Mr. A. Chaston Chapman, F.R.S., the Chairman. The Streatfeild Prize for excellence in practical chemistry was handed to Mr. F. L. B. Revis by the lecturer.

THE chemical industries have received an unusual share of attention during the last few years on account of their importance in the war and of their position among what are popularly but loosely called "key" industries. Whatever view we may take as to the economic conditions under which such industries best flourish, all who have any claim to speak on the matter are agreed that the first requirement, without which no chemical industry can live, is an adequate supply of trained chemists, not merely for the analysis of materials and products and for the conduct of routine manufacturing operations, but also for investigation and discovery. It is not enough for industrial chemists to preserve and use existing technical knowledge, but they must add to it. Many of us hold that the actual direction of the industry should be largely in the hands of such technically trained experts, and that the frequent absence of such direction is one of the most potent causes of weakness in the industry. The transfer of the control of manufactures from the technical chiefs to boards of financiers and commercial men is a serious fact of the day, deserving the careful attention of all who are interested in the relations of science and industry. It leads inevitably to concentration on finance rather than on manufacture, and to the making of profits assuming greater importance than the making of goods. To follow up this subject would lead me into controversial regions, and I must turn to the safer ground of technical training.

Whatever branch of industry we may take as an example, a training in its methods and processes must be based on a broad foundation of general science, that is, of mathematics, physics, and chemistry. Once that foundation, common to all technical work, has been laid, we may proceed to specialise. But not too early. Specialisation in science and in technology is necessary and inevitable, but it is an evil if uncontrolled, and may result in a dangerous narrowness of outlook. Some day, when we have escaped from the meshes of the examination system, we may see a truly scientific education in which the physical, biological, and social sciences will be so correlated that even the technological student of moderate attainments may gain a synthetic view of science as a whole, as a background to the special studies which are his immediate object. In the meantime we can take measures to avoid, by a thorough training in these three fundamental sciences, the dangers of a too partial view. In this respect the old Finsbury training was highly successful.

The present position of chemistry is a good illustration of the increasing tendency of science

towards subdivision and specialisation. A chemist—without further qualification—is rarely met with at the present day. In his place, we meet with physical chemists, organic chemists, food analysts, colloid chemists, chemical engineers, and many other specialists. It is commonly taken for granted that a chemist who has chosen one of these specialisms as a life-study cannot be expected to have much acquaintance with any of the other departments of the science, and ignorance of other branches of chemistry is scarcely considered to be a reproach. We have all met with chemists who have become in course of time so intimately associated with some small section, such as the chemistry of the azo-compounds, as to abandon all interest in the remainder of the science. The opinion is widely held that chemistry is too vast a subject for an individual to master, and if by any chance an exceptional person should be found who persists in retaining an interest in the whole field of chemistry, refusing to regard his science as an aggregate of unrelated specialisms, he is lucky if he avoid the taunt of being a mere populariser of science, a smatterer among experts. I venture to hold that this view is wrong, and that chemistry needs more men who, whilst acquiring as full a knowledge as possible of some restricted field, yet retain a mental picture of the science as a whole, and follow with interest its general progress.

My subject to-day is the metallurgical chemist, the representative of one of those specialisms of which I have spoken. There is some excuse for his separate existence, for he has a history of his own. Whilst the alchemist, engaged in laboratory experiments with metals, was the ancestor of the modern scientific chemist, the practical metallurgist, extracting and smelting the ores of those metals, has a long record of independence. The miner and the metal smelter, the first scientific representative of whom was Georgius Agricola in the 16th century, laid the foundations of the new science of geology, whilst accumulating a mass of material to be utilised, when the time came, by the scientific chemist. Even now, theoretical chemistry finds a rich field of experimental facts in the processes of smelting and alloying metals, whilst the needs of the metallurgist have been the impetus to the development of a large part of analytical chemistry.

The dominating position of the metallurgical industries in our Western civilisation—all our industries, even that of agriculture, being so largely dependent on a supply of suitable metals, especially of iron and steel—gives particular importance to the metallurgical chemist in an industrial society. His training is undertaken by special colleges or

departments of universities, and has to combine instruction in the chemical and physical principles of metallurgy with practice in the typical operations of the works and laboratory. Quantitative analysis rightly occupies a foremost place in the training of chemists, no other practical discipline giving quite the same combination of manipulative skill with confidence in the reality of the facts observed and in the conclusions drawn from them. When metals are the special object of study, this character of work in quantitative analysis is particularly conspicuous, hence the stress laid upon it in any good course of metallurgical instruction. To make a full analysis of a high-speed tool steel, which may contain, in addition to carbon, silicon, phosphorus, sulphur, and manganese, which have to be estimated in every steel, nickel, cobalt, chromium, molybdenum, tungsten and vanadium, is an exercise demanding a high degree of skill and also an understanding of questions of valency, reactions of oxidation and reduction, and other matters of theoretical importance. The degree of accuracy required in such analyses for commercial and technical purposes is surprising to a chemist unaccustomed to such work, and far in advance of the standard usually accepted in academic laboratories. When a steel specification fixes an upper limit for the phosphorus of 0.40 per cent., and a delivery may be rejected if the analysis shows 0.41, and this is a typical case, great accuracy is essential, and the young chemist must be prepared to have his results challenged and the analysis repeated by referees in cases of doubt. Speed as well as accuracy are required, and the methods employed in works frequently differ from those adopted in outside laboratories, not in being less exact, but in being more rapid. The analysis of the bath samples taken from an open-hearth furnace during the working of a charge may be taken as an example.

It is true that the manipulative skill necessary to enable an analyst to estimate the usual elements in ordinary steels may be acquired by practice and by constant observation of expert workers, since the analytical methods have been reduced to a standardised routine, and a practised hand may make accurate analyses by following a prescribed ritual, without an understanding of the underlying principles. It is a fact that much of the work in steel laboratories and assay offices is performed by such empirically trained assistants, and it is not inconceivable that it may at some future time be done by mechanical means, as the composition of flue gases is now determined automatically by a CO_2 -recorder. But when the analytical work embraces a variety of complex alloys, something more than mechanical skill and accuracy is required, and the analyst finds the necessity of a scientific training, and it may be said that no analyst devoid of chemical knowledge could deal satisfactorily with the wide range of materials passing through a modern steelworks laboratory. Dexterity in analysis, however, is only one of the requirements of the metallurgical chemist. Comparatively few of the graduates or holders of college diplomas in metallurgy intend to remain in the laboratory during their professional career. In many large steelworks it is the practice for the young graduate to enter the works laboratory, and to spend such time there as is necessary to become familiar with the methods, materials, and products of the establishment, and

then to pass out into one of the other departments of the works, such as the melting shop, forge, or rolling mill. The head chemist is necessarily a permanent official, controlling all the analytical work, but his assistants may be drawn largely from such temporary colleagues.

Chemical knowledge is required in the conduct of other metallurgical operations, and the working of an open-hearth charge of steel, for example, is an operation on the large scale, involving the delicate control of a number of complex and highly interesting chemical equilibria. But the properties and the uses of metals depend on their physical condition as well as on their chemical composition, and it may be said with truth that metallurgy is the application of the laws of physics and chemistry to the special case of metals. Hence the necessity of a good knowledge of physics. Physical instruments are in every-day use in the works. For instance, temperatures are measured by means of the thermo-couple or the electric-resistance pyrometer, or, if too high for metal wires to be used, by instruments that measure either the total radiation or the intensity of radiation of a particular wave-length. Such instruments may be set up and read by an intelligent but untrained workman, but to direct their use, to calibrate them when installed, and to determine their errors after wear, calls for a good understanding of the principles on which they are designed and of the possible sources of error. The heat treatment of steels, again, is governed by a knowledge of their critical or transformation temperatures, and such knowledge is obtained by making certain delicate determinations of the development or absorption of heat, or of discontinuous changes in the volume, electrical resistance, or magnetic permeability, introducing a large range of instruments, so that a steel-works laboratory may rival that of a college in the completeness of its physical equipment.

Microscopical metallography, that wonderful method of investigation introduced by H. C. Sorby, has established itself so firmly that no modern metallurgical or even engineering works can afford to be without microscopical equipment. The mechanical and physical properties of metals and alloys depend on their crystalline arrangement and on the distribution of their constituents as well as on their composition. Physical chemistry has shown that alloys are to be considered as solidified solutions, and the metallurgical chemist has therefore to master the technique of metallography, which is not difficult, and also to learn how the structures observed are to be interpreted, which is less easy. The study is a fascinating one, and skill in it is one of the most valuable accomplishments that the young metallurgist can acquire. A later development has even found its way into industry. The work of Laue and the Braggs has shown how the internal architecture of metallic crystals, on which depend such properties as strength and ductility, may be determined by means of X-rays, and a whole new field of work is thus opened up.

There is another side of metallurgy besides that which deals with cast or worked metals that may appeal to many students, namely, that which concerns the mining and preparation of ores. For such work a training in geology is required, and the student may specialise in the study of raw materials, and undertake prospecting work or find occupation in connexion with mines. Every metal-

lurgist needs an acquaintance with mineralogy in order to understand ores, fluxes, and refractories, all of which he encounters in his daily work. Above all, however, the metallurgist must be a chemist, so fully trained in the fundamentals of his science as to adopt immediately and unconsciously a scientific attitude towards the problems that present themselves in the course of his work. He must have a knowledge of the sources of information at the disposal of the chemist, and must be prepared to follow the progress of chemistry, closely as regards his own special section, and in broad outline that of the science in general. This involves the ability to abstract literature, if possible French and German as well as English.

It may be thought that I have been describing an Admirable Crichton, possessed of all the accomplishments, but such a training is actually within the capacity of a good student pursuing a three or four years' course after matriculation. All branches of industrial chemistry, metallurgy among the number, need a supply of such trained men as managers, chemists, and research workers, and the universities and colleges will have to provide, in an increasing degree, such men for the needs of industry. There is one danger against which I would warn metallurgical, or indeed any technical students. It is that of despising the practical man in the works, the skilled smelter, steel hardener, shop foreman, or roller, because he makes dogmatic statements in unscientific language. The skilled workman is usually right in his facts, allowance being made for some old prejudices, and his explanations are less absurd than they appear to the academically trained novice in industry. Long experience of metals in the workshop often gives a wonderfully thorough, and apparently instinctive, knowledge of their behaviour. Even the explanation may be merely the survival of an obsolete mode of expression. When one watches the process of puddling iron one sees at a certain stage of the process small flames on the surface of the molten mass. The puddler will explain that these are the "sulphur" burning off. The chemist, knowing that sulphur is not eliminated at that stage, and that the flames are of carbon monoxide, may regard the statement as nonsense. It is, however, merely a survival from the time when chemists generally used the word "sulphur" to denote the combustible constituent of any substance, and in this case the carbon is actually being removed, the puddler expressing the fact in the scientific language of an earlier generation. The trained chemist must learn to respect the knowledge of the practical man, and to utilise his wide experience in the construction of his own more orderly and logical system of technological doctrine and practice. The best way of avoiding the dangers that beset a purely academic chemist when he enters industry is to gain experience by direct contact while still pursuing the course of college instruction. This may be done, in most instances, by passing a part of each summer vacation in works, an arrangement for which metallurgical employers have ungrudgingly given facilities. Such experience is essential in order that the student may acquire the sense of the importance of scale on which success in technical processes so largely depends. So, too, he learns to know the machines and plant in a more direct way than from diagrams or models. Some engineering knowledge he must have, the outlines of which are imparted to him in

his academic training, and whilst comparatively few metallurgical chemists specialise on the side of machinery, they must all be prepared to co-operate with engineers, and to understand their point of view.

As representing a university situated in the midst of a great industrial area, and in the closest touch with the dominant industries, I can speak of the vital importance of technical education to the city, the nation, and the wider civilised community. The methods of industry are changing; rule-of-thumb and secrecy are disappearing, and with the growing recognition that the reckless waste of natural resources is a crime against society, a more scientific period is in sight. All who look forward to that improved state of things will recognise with gratitude the pioneer work of Finsbury in that direction, the great services of its able and devoted staff, and the debt that all its students, of whom I am proud to have been one, owe to them, and not least among them to Streetfield, the patient, admirably efficient, and well-loved teacher in whose memory this lecture has been established.

PERSONALIA

The Nobel Prizes for Chemistry for 1921 and 1922 have been awarded, respectively, to Prof. F. Soddy and Dr. F. W. Aston. The Prizes for Physics have been awarded to Prof. A. Einstein, of Berlin, and Prof. N. Bohr, of Copenhagen.

Dr. S. W. Stratton, for 21 years director of the U.S. Bureau of Standards, has accepted the presidency of the Massachusetts Institute of Technology; and Mr. F. B. Tough has succeeded Mr. A. W. Ambrose as chief petroleum technologist to the U.S. Bureau of Mines.

The Howard N. Potts medal of the Franklin Institute has been awarded to Messrs. C. R. Downs and J. M. Weiss, of New York, for their work on the catalytic oxidation of benzene to maleic acid and on the development of an industrial process for converting aromatic into aliphatic compounds.

The gold medal for the best paper presented at the Annual Meeting of the American Society for Steel Testing has been awarded to Mr. E. J. Janitzky for his thesis on "The Influence of Mass in Heat Treatment," and the second prize to Messrs. Gill and Bowman for their paper on "The Constitution of High-Speed Tool Steel."

Among the awards made by the President and Council of the Royal Society are:—The Copley medal to Sir Ernest Rutherford, for his researches in radio-activity and atomic structure; the Rumford medal to Prof. P. Zeeman, for his researches in optics; the Davy medal to Prof. J. F. Thorpe, for his researches in synthetic organic chemistry; the Buchanan medal to Sir David Bruce, for his researches and discoveries in tropical medicine; and the Hughes medal to Dr. F. W. Aston, for his discovery of the isotopes of a large number of the elements by the method of positive rays. The Royal medals have, with the approval of the King, been awarded to Mr. C. T. R. Wilson, for his researches on condensation nuclei and atmospheric electricity; and to Mr. J. Barcroft, for his researches in physiology, and especially for his work on respiration.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The Chamber of Deputies is now considering a Bill to develop the production of sodium carbonate and caustic soda in France. Until recently there were only three factories producing these chemicals, all of which were situated in the district of Nancy, and consequently exposed to destruction in case of invasion. For this reason a company named La Société d'Etudes et Produits Chimiques was formed early in 1918, to manufacture sodium carbonate and caustic soda at Mouguerre, near Bayonne, but owing to the high costs of materials and labour, the progress made in the construction of the factory was very slow, production was not started until the end of 1919, and even now the daily output does not exceed 20–30 tons. The Government now realises the importance of a steady production in a locality not exposed to invasion, and it is considering the grant of a loan of 8 million francs, at 6 per cent. interest, to enable the company to raise the capacity to 100 t. of sodium carbonate (96–98 per cent.) per day, a quantity which could be converted into 75 t. of 72 per cent. caustic soda. Until the loan has been repaid the company cannot raise further money without the consent of the Treasury. This proposed arrangement is also interesting in that it probably indicates the intention of the State to take in hand the organisation of production for war-time requirements.

Coal Dust as Fuel.—The question of finding a substitute for petrol as a fuel for internal-combustion engines loses none of its importance, and tests have recently been made in the northern mining areas on the inflammability of coal dust in various degrees of sub-division and concentration. The results show that very finely-divided coal dust remains suspended in the air almost indefinitely, and that when rich in volatile matter it forms a very explosive mixture with air. Tests are now to be carried out to ascertain the possibility of using such an explosive mixture in internal-combustion engines. Progress has been made by the successful use in these engines of "colloidal" coal—a suspension of "coal" dust in heavy vegetable oils—the dust being prepared from French lignites, and the oils derived from French West Africa. According to Monsieur Lance, 150 g. of powdered lignite will yield on combustion in one cb. m. of air 825 calories, or as much as 75 g. of petrol. Allowing for different densities, 1 litre of petrol costing 1·80 francs could be replaced by 1·45 kg. of pulverised lignite worth about 0·45 fr.

Metallurgy.—The following statistics of production of pig iron and steel during the period January 1 to June 30, 1922, have been prepared by the Comité des Forges de France:—

	1922	1921	1921	Pre-war
		1st half	2nd half	
	Metric tons	gain or loss per cent.		
Pig iron ..	2,294,895*	.. +27·5	.. +42	.. —49·5
Steel ..	2,057,406 t.	.. +33·7	.. +31·5	.. —41

* 34,895 t. in electric furnaces.

The greatest increase in production of both iron and steel has occurred in Eastern France, including Lorraine. There are now 92 blast furnaces in operation, compared with 73 on January 1 last. Of the total steel production, Thomas and Martin steel

now represent 98·1 per cent.; the manufacture of Bessemer steel is declining steadily.

Extraction of Bromine and Potash in Tunisia

An article on the extraction of bromine and potash from the salt marshes at El Hanèche in Tunisia during the war is published in the September issue of *Chimie et Industrie*. Owing to the high price and insufficient supplies of bromine then being obtained from the United States, a factory was erected at El Hanèche, which from April 28, 1916, up to the date of the armistice supplied a total of 1050 metric tons of bromine to the Allies. To-day the factory no longer exists, but it was in operation long enough to provide the essential data that would be required to establish a bromine industry in Tunisia. The remainder of the information given is covered by an article which appeared in the *Bulletin de la Société d'Encouragement* in Jan.-Feb., 1919, and was abstracted in this *Journal* (1919, 146 R).

AUSTRALIA

British Phosphates Commission

The report of the Commission for the year ended June 30, 1922, states that exports from Nauru and Ocean Islands reached the record total of 364,251 tons, of which 72·96% went to Australia, 4·70% to New Zealand, 4·59% to the United Kingdom, and 17·75% to other countries. This output approaches the maximum possible with the existing plant. Sales of phosphates and sundry credits amounted to £1,304,740, and the cost of phosphate f.o.b., together with £222,521 for interest, sinking fund, etc., was £688,957, and freights £613,097. The credit balance of £2685 was transferred to reserve account, and cash in hand amounted to £18,853. The phosphate rights, plant, etc. are valued at £3,325,770 and stocks at £298,250. Liabilities are divided as follows:—British Government, £1,571,483; the Commonwealth, £1,517,113; and New Zealand, £577,860.—(*Ind. Austr.*, Aug. 31, 1922.)

Cane-Sugar Crop in Queensland

Returns published by the Registrar-General of Queensland show that in 1921 the crop from 184,513 acres of sugar-cane was 2,287,416 tons, which yielded 282,198 tons of sugar (94 n.t.) and 10,734,399 gallons of molasses. In 1920 the crop from 162,619 acres was 1,339,455 t. and the yield of sugar and molasses 167,401 t. and 6,175,868 galls., respectively.—(*Ind. Austr.*, Aug. 10, 1922.)

Lead-Poisoning at Broken Hill

The final report of the Barrier Technical Commission appointed to report on health conditions at the Broken Hill mines states that of 6538 mine workers examined, only 61, or 0·9 per cent., were found to be suffering from lead poisoning, and only 27 of these had worked exclusively underground. Among surface workers, 5 out of 823 general labourers, and 1 out of 774 mill-hands were found to be affected. It was concluded that all men working in or about the mines were exposed to the action of lead circulating in the blood, but chemical analyses showed that the concentration of lead was low. The Commission recommends that susceptible persons be removed from exposure to lead poisoning and that the disease be made notifiable in certain localities.—(*Mining Mag.*, Sept., 1922.)

CANADA

Industrial Notes

The Canadian Salt Company has commenced the manufacture of liquid chlorine at Sandwich, Ontario. The present output is ten tons a day.

The Hull Electric Co. has acquired the riparian rights to the Pagan Falls, on the Gatineau River, Quebec, about 35 miles north of the city of Ottawa. The company will establish a hydro-electric plant with an ultimate capacity of 150,000 h.-p., at a cost of approximately \$10,000,000.

The Shawinigan Water and Power Co. is contemplating the development of 150,000 h.-p. at Gray Falls, on the St. Maurice River, about six miles below Shawinigan. This work will be commenced next spring, and will entail an investment of approximately \$10,000,000 to \$15,000,000.

Lakefield, Ont., will probably be the first place in Canada at which the development of electric power from surplus heat will be carried out. The Canada Cement Co. is planning to secure 2000 h.-p. for its new plant there by converting the waste heat from the kilns into electrical energy, which will be utilised to raise steam. This system is successfully operated in other countries.

The experimental lignite-briquetting plant, near Bienfait, Sask., which is under the direction and control of the Advisory Council for Scientific and Industrial Research, and upon which \$1,000,000 has been expended, is not giving satisfaction. The Press states that the Federal Minister of Mines is not satisfied and is calling for an independent report upon the plant. It is intimated that the Government is not favourable to further expenditure under the present circumstances. The ex-Minister of Mines had certain features of this undertaking investigated and the report was unfavourable.

Mining and Metallurgy

The Manganese and Steel Foundry, Ltd., of the United States, is erecting a branch factory in Sherbrooke, Quebec.

The Globe Mining Co., operating about 36 miles from Cranbrook, British Columbia, has discovered a seam of sienna from 8—10 feet wide.

The Government of Quebec announces that the royalty on asbestos has been reduced from \$5.00 to \$2.50 per ton. The reduction, however, is subject to certain provisions contained in the Order-in-Council.

The returns of the Department of Mines, Ontario, for the first half of 1922 show a record gold production of 476,322 oz., and it is probable that the value of the output for the full year will exceed \$20,000,000. The production of silver was 4,774,666 oz., and that of copper, nickel, and cobalt also improved.

The offer of the British Government to collaborate in financing the Coast Range Steel Co., British Columbia, is contingent upon thorough investigations being made independently by the Provincial Government, the Dominion Government, and the British Government; if satisfactory, the last-named will advance certain monies to be expended in Great Britain on purchasing equipment for the steel-mill.

The estimated value of the minerals produced in the Dominion during the first six months of 1922 is \$57,682,944, metals being worth \$26,475,544 and non-metals \$21,207,400. This result shows an increase, in value, of 9.1 per cent. over the correspond-

ing period in 1921. The principal returns are as follows:—Coal \$24,346,959, gold \$12,110,202, silver \$5,997,199, lead \$2,882,047, natural gas \$2,448,824, copper \$2,337,093, asbestos \$1,894,232, nickel \$1,401,820, zinc 1,370,460, and salt \$849,133. Owing to strikes there is a marked decline in the production of coal, nickel, and copper.

The entry of the H. W. Johns-Manville Co., of New York, into the Quebec asbestos mining area, by securing an option upon the Martin-Bennett properties, and the erection of a large plant for the manufacture of all kinds of asbestos products, has been followed by the possibility of the company obtaining possession of the Black Lake and East Broughton properties, controlled by Jacob A. Jacobs, Montreal. The American company is not going to have the field to itself, as a large British asbestos firm, with head office in London, has decided to merge with an Eastern Township (Quebec) mining firm, and the Asbestos Manufacturing Co., Ltd., of Montreal. The new company will be known as the Asbestos Manufacturing Co. of Canada, and its capital will be \$2,000,000. The present plant, at Lachine, Que., will be enlarged and improved to meet the requirements of the new company, which will manufacture packing, textiles, and all kinds of asbestos products. It is probable that the Hon. P. J. Paradis, M.L.C., will be the president of the new company.

UNITED STATES

Earnings of Chemical Companies in 1920

Financial returns for 1920 forwarded to the internal revenue authorities by 5826 manufacturers of chemicals and allied products, disclosed a total gross income of \$5,565,125,606 and a total net income of \$344,929,904, on which taxes amounting to \$98,163,376 were paid. Only 3047, or 52.3 per cent., of the companies reported a net income; the remainder had a gross income of \$1,027,030,330 and a deficit of \$96,439,756.—(*Oil, Paint and Drug Rep.*, Oct. 2, 1922.)

Talc and Soapstone in 1920

The total production of talc and soapstone in the United States in 1920, according to the U.S. Geological Survey, was 224,290 short tons, valued at \$3,090,265, an increase of 21 per cent. in quantity and 31 per cent. in value compared with 1920. Output increased in all producing States, except North Carolina, which, however, is only a small producer. No soapstone is imported, but the import of talc, 22,680 t., was the largest on record. Imports from Italy returned to the pre-war level, and those from France recovered substantially, but the largest quantity (15,123 t.) came from Canada. As there were no exports of talc, the apparent consumption was 246,970 t., the average value per ton being \$14.34.

Investments in Chemical Education, 1920-21

The National Research Council has collected the following information concerning the amount of money invested in the teaching of chemistry in about three-fourths of all the universities and colleges in the United States during the academic year 1920-21:—

The 417 institutions that reported possessed buildings and equipment valued at approximately \$28,230,784, in addition to new buildings under

construction and their equipment valued at \$7,553,300, the latter sum including \$2,000,000 for Cornell University and \$1,866,900 for Yale University. Endowment funds received during the year totalled \$525,868, and the cost of maintaining the chemistry and chemical-engineering departments, including salaries, chemicals, etc., was \$7,739,970. There were 3613 graduates and 109,128 undergraduates taking courses in chemistry, and 302 graduates and 5585 undergraduates studying chemical engineering (where a separate department is maintained). The State of New York had the largest amount, viz., \$6,790,015, invested in chemical education.—(*J. Ind. and Eng. Chem., Mar.*, 1922.)

SOUTH AFRICA

Life of the Rand Gold Mines

The Transvaal Chamber of Mines estimates the ore-reserves of the Rand gold mines as follows (million tons):—Producing mines 695; old producers, closed down, 60; partly developed, but not promising, 60; undeveloped areas 225; total 1040 million tons, or sufficient to last 50 years at a high rate of production or 70 years with normal vicissitudes and a languishing end. Extensions of the gold field to the south-west are probable, but when once the great mines are exhausted there will be no chance of revival under conditions at present conceivable.—(*Mining Mag., Sept.*, 1922.)

GERMANY

The Gasification of Crude Brown Coals

In order to elicit possible solutions of the problem of completely gasifying raw, ungraded, earthy brown coals with a high moisture content, the Brennkrafttechnische Gesellschaft is offering a prize for open competition. Competitors have to submit either a process or a plant and must supply an illustrated account supported by accurate quantitative data. The Gesellschaft acquires the copyright of all theses submitted but will have no right to use the processes described.

High-Pressure Steam

According to the *Industrie-und Handels-Zeitung* of October 1, a steam turbine is being erected in Berlin which will work under a steam pressure of 1600 lb. per sq. in. The steam is discharged from this turbine at about 190 lb. per sq. in. and then enters an existing turbine in which its expansion is completed. It is stated that the technical difficulties of generating steam at this high pressure have been overcome by using the recent invention of a Swede and that the experiments made have given very good results.

Is Radium a Medicament?

A German court of justice decided that radium is not a medicament because its action, like that of Röntgen rays, is purely physical, and because when used it does not suffer an appreciable loss within a limited time. This ruling has, however, recently been put aside by the Berlin Court of Appeal on the grounds that according to the methods of preparation and packing, radium is clearly intended for use in curing, alleviating or preventing diseases in man and animals, and the case is to be re-tried in another provincial court.—(*Chem.-Z.*, Sept. 23, 1922.)

"Weinschenkite," a New Rare-Earth Mineral

In the *Berichte* for October 14, F. Henrich reports the occurrence of a new mineral containing 52.47 per cent. of rare earths (about 4 parts of yttria to 1 of erbia), and 30.2 per cent. of phosphoric anhydride, the loss on ignition being 16.42 per cent. These figures agree fairly well with the formula $\text{XPO}_4 + 2\text{H}_2\text{O}$ ($\text{X} = \text{Er}$, Y , etc.). The mineral, which has been named "Weinschenkite," occurs in small quantities in the iron-ore district of Amberg-Auerbach in Bavaria, and appears as white, felted, round masses, and also as stellate needles on limonite. A very rare mineral containing 2 to 3 per cent. of rare earths and 13 per cent. of calcium oxide named "pseudo-wavellite" occurs in the same locality.

BRITISH INDIA

First Forecast of the Indigo Crop

The following statistics refer to the six provinces which contain practically the whole area under indigo in British India:—

Province	First Forecast				Yield per acre (lb.)	
	1922-23	1921-22	1922-23	1921-22	1922-23	1921-22
Madras ..	102,600	114,500	23,000	28,000	25	27
United Provinces	35,000	42,000	4,200	4,800	13	13
Bihar & Orissa ..	35,200	39,900	4,300	4,900	14	14
Punjab ..	37,500	21,200	7,600	2,900	23	15
Bengal ..	7,300	11,100	300	400	5	4
Bombay and Sind (including Indian States)	0,300	8,600	1,600	1,500	19	20
TOTAL ..	226,900	237,300	41,000	42,500	20	20

—(*Ind. Tr. J.*, Oct. 19, 1922.)

GENERAL

Manchester College of Technology

The degree of Bachelor in Colour Chemistry has been created at this college with the object of training chemists for the dyestuffs industry. From the present session onwards it will be possible to obtain the degree of B.Sc. Tech. in the section of colour chemistry. At the annual meeting of the Evening Students' Chemical Society the following officers were elected:—President: Prof. F. L. Pyman; Vice-presidents: The Principal, Prof. Knecht, Capt. Sinnatt, and Messrs. Huebner, Radcliffe, Roberts and Allan. Joint hon. secretaries: Messrs. S. Rowbottom and J. Haslam.

The Logwood Industry in Haiti

Logwood is one of the leading articles exported from Haiti, and the United States is the chief consumer. Statistics showing the reserves of logwood are not available, but the Baho district, which produces well-matured wood, yielding one barrel (about 500 lb.) of extract per ton, is estimated to contain 500,000 to 1,000,000 tons. Large quantities have been obtained from the district around Port de Paix and Mole St. Nicholas, but the district near Cape-Haitien is largely exhausted and the wood now obtained from it is of secondary growth. Haitian logwood is mainly exported in a crude form, but shipments of extract are increasing, and an American corporation has erected plant at Grande Rivière at a cost of \$150,000 to produce 400 barrels of extract per month. At present the industry is only occasionally active, and exports of logwood have declined from 108,106 tons in 1920 to 33,434 t. in 1921; in 1920, 31 t. of extract was exported, as

compared with 119 t. in 1919. Prospects are not favourable, but trade would improve with a revival in the textile industry of the United States.

Prospects of an Alcohol Industry in Palestine

The Department of Commerce and Industry of Palestine has collected information relating to the possibility of establishing an alcohol industry in the country. Imports of alcohol in 1921-22 were 561 tons, and the production was 117 metric tons, all from grape juice; also 0.62 tons made in experiments on the fermentation and distillation of durra. Barley and wheat are suitable raw materials as they yield 31 and 33 litres of alcohol per 100 kg. of grain, respectively, and production is in excess of the demand. The durra crop is another useful source, and maize, which yields 19 to 37 l. per 100 kg., could be grown in certain areas if a market were available. The potato crop, though increasing, is too small to be used except for food, and the use of sugar-cane, now being grown experimentally, for the manufacture of power alcohol, would be too costly. Data are needed of the yields from prickly pears and acorns, of which ample supplies are available.

Monazite in the Malay Peninsula

An account of the occurrences of monazite in the Malay Peninsula, and of the properties and identification of the mineral, has been prepared for the Federal Council of the Malay States. There is good reason to believe that monazite is present in the granites and granitic rocks of Malaya, but probably not in quantities worth exploiting. It is found in many localities in detrital deposits, often in association with tin ore, and occurs most abundantly in the alluvium of the rivers of Kemaman, a concentrate from which contained 5.30 per cent. of thorium (ThO_2). The content of thorium in monazite from other localities is given as follows (per cent.):—Sempam (concentrate) 8.38, Baias Tujoh (sample) 4—5, Dindings 8.7, Puchong Babi 3.40, Kulim (Kedah) 3.53, Kelantan 9.41. Proximate analyses of specimens from the three last-named localities showed contents of 66.27, 61.05, and 60.00 per cent., respectively, of ceria, lanthana, and allied oxides. A copy of the paper may be consulted at the Malay States Information Agency, 88, Cannon Street, London, E.C. 4.

The World's Production of Sugar

Figures showing the world's production of sugar in 1921-22 and the preliminary estimates of the 1922-23 crop are given below:—

	1921-22	1922-23
	Thousands of Short Tons.	
United States:		
Beet	911 ..	581
Louisiana cane	290 ..	208
Cuba	4,000 ..	3,600
Porto Rico	385 ..	..
Dominican Republic	225 ..	510
Java	1,650 ..	1,659
Australia	299 ..	300
Fiji Islands	65 ..	62
Mauritius	200 ..	250
Natal	150 ..	140
Formosa and Japan	425 ..	325
British India	2,500 ..	2,500
Europe	4,088 ..	4,600
Other countries	2,302 ..	2,275
Total	17,490 ..	17,000

—(U.S. Com. Rep., Sept. 4, 1922.)

Fertilising Value of Basic Slags and Rock Phosphates

In the *Journal of the Ministry of Agriculture* (Sept., Oct., 1922) Dr. G. Scott Robertson summar-

ises recent work upon the relative value of different types of basic slag and rock phosphate. On hay and pasture rock phosphates produce the same type of improvement as the most soluble types of open-hearth basic slag, and they are more effective than the open-hearth, low-soluble fluorspar slags. In districts with high rainfall and acid soil the efficiency of the low-soluble slags may approximate closely to that of the more soluble types. In general, the value of the fluorspar basic slags is 50—70 per cent. of that of the high-soluble slags. Rock phosphates were found to have a much higher fertilising value than has been admitted, and on sour, damp soils they may even prove superior to the best grades of basic slag.

Mercury Ore in China

The chief deposits of mercury ore in China occur in the provinces of Kweichow, Hunan, Yün-nan and Szechwan, of which the most important is that in Kweichow, which consists of a broad belt of cinnabar associated with stibnite and extends into Hunan. The largest mines at Yuanshankiang, 15 miles from Lungchikow, were opened in 1898 by a foreign company, but development has been slow. Cinnabar occurs in Hunan to the west of Fenghungting, near the Kweichow border, and the chief mines are at Hontzeping and Tatungla. This mineral is also obtained by washing in the bed of streams in western and northern Yunnan, and especially in south-western Szechwan. At Hangeho, in the Yen-yuan district of Szechwan, a mine worked on a fairly large scale supplies cinnabar to the important vermilion industry at Chungking.—(*Ch. of Comm. J.*, July 7, 1922.)

Organisation of the Mining Industry in Russia

After Soviet government had been established in Russia, the industrial resources of the country were placed under a Supreme Board of Industrial Economy which controlled a number of general committees appointed to administer particular industries; the chemical industry was one of these, but a specific Section of Mines was not formed until the end of 1919, and in the following year a Council of Mines was also appointed. The organisation of the Council was very systematic, but it did not work, owing to lack of skilled direction, political friction, deficient means of communication, etc. Commissions of specialists were sent from time to time to inspect and report upon mines, particular attention being given to the coalfields in South Russia owing to the fuel crisis. In the summer of 1921 these coalfields were organised in a separate unit, and some improvement ensued; but the petroleum industry in the Caucasus remained in a critical position and metalliferous mining practically ceased. In October of the same year a general reorganisation took place, and the Council of Mines was converted into the General Administration of Mining Industry, the general committees becoming sections, each under a technical department consisting of mining specialists.

The only important work done by the General Administration has been the collection of statistical data, and the compilation of geological and other reports which will be of great use to the investor. Very little real work has been done on the mines during the last four or five years, and there is a great lack of technical equipment.—(*Min. and Met., Aug.*, 1922.)

REPORTS

REPORT OF THE FOOD INVESTIGATION BOARD FOR THE YEAR 1921. Pp. 47. London: H.M. Stationery Office, 1922. Price 2s.

The Report of the Food Investigation Board for 1921 includes accounts of a number of investigations of interest to the chemist, especially in the sections dealing with the work of the Meat Committee, the Oils and Fats Committee and the Fruit and Vegetables Committee.

The only point to be noted in the report of the Fish Preservation Committee is that autolytic reactions were found to proceed in the liver of herrings stored at the low temperature of about -7°C .

The report of the Meat Committee includes an account of researches carried out by Miss D. L. Foster and Miss D. M. Moyle on the effect of exposure to low temperature on the lactic-acid metabolism of amphibian muscle, the results of which have already been published in the *Biochemical Journal*, as have also the results of an investigation on the source of energy of muscular contraction. It was shown that during chopping, rigor and recovery from fatigue there is a change from glycogen to lactic acid or *vice versa*; another important fact that has been discovered is that the muscle possesses the power of synthesising hexose-phosphate from glucose and sodium phosphate. Miss Foster has also repeated experiments on the effect of the rate of freezing on the autolysis of beef. She has confirmed her earlier observation that the more rapidly the beef is frozen the more closely does the autolysis on thawing follow the course in that of fresh unfrozen beef.

The inquiry of the Fruit and Vegetables Committee follows three main lines, the preservation of apples by cold and gas storage, the chemistry of the ripening processes and the diseases of the stored fruit. The results of the cold storage tests have shown, as might be expected, that 1°C . is a better temperature of storage than 3° or 5°C . It also appears that the soil on which the apple trees grow influences the capacity of the fruit for storage, a silt soil being more suitable than clay or green-sand, whilst chalk, clay and fenland are stated to be progressively less suitable. But as the fruit was not all gathered from trees of the same age it is not clear how far the results are really to be attributed to soil differences or to the age of the tree, or possibly to other factors.

The gas-storage method consists in keeping apples in an atmosphere containing 5 to 8 per cent. of oxygen, and 12 to 15 per cent. carbon dioxide, the rate of respiration of the fruit being presumably reduced by this means. In this connexion the rate of respiration of the apple Bramley's Seedling was followed throughout its storage at three temperatures: 2.5° , 10° and 22.5°C . The rate of respiration at first increases, reaches a maximum and then falls. At the three temperatures employed the maximum is reached on the 180th, 28th and 7th day of storage, respectively.

Mrs. M. W. Onslow has investigated a large number of fruits for the presence of oxidising enzymes; the results have already been published in the *Biochemical Journal*. Work has now been commenced on acids in the apple, and methods have been devised for the estimation of malic acid and

malates, including titration and estimation of acid and malates as the lead salt. Special attention has been devoted to the estimation of the acid in small quantity. Tests for a number of enzymes in the apple have been made and tyrosinase and reductase have been detected.

In the work of the Oils and Fats Committee Prof. R. Robinson and his collaborators have continued investigations on the nature and constitution of the acids occurring in natural fats. Work on the synthesis of unsaturated acids of the C_{18} series has been continued; octyl bromide was condensed with the compound $\text{AgC}:\text{C}(\text{CH}_3)_2\text{CO}_2\text{Me}$ in boiling isoamyl ether and this gave a small yield of the ester, $\text{CH}_3(\text{CH}_2)_7-\text{O}:\text{C}(\text{CH}_3)_2\text{CO}_2\text{Me}$, which after catalytic reduction and hydrolysis gives homostearic acid. Heptyl bromide leads in the same way to stearic acids.

Prof. A. Lapworth and Mrs. L. Pearson have commenced the study of oleic acid and have come to the conclusion that the subject needs complete revision; the existing methods for isolating the acid are unsatisfactory, and the properties of the pure substance have not been ascertained with certainty. A method has been devised by which the proportion of saturated acid in the final product is reduced to a minimum; this is based on freezing out the ether or benzene solutions of the mixed lead salts with subsequent recrystallisation of the barium salts from mixtures of moist benzene or toluene and amyl or ethyl alcohol. Other investigations carried out under the auspices of this committee include one on the constitution of mannitol fat (the synthetic fat obtained by the interaction of mannitol and olive oil) by Miss H. Gilchrist, and a study of the conditions affecting the formation of fat by yeast by Dr. I. S. MacLean.

Accounts of the work of the Engineering Committee and the Canned Foods Committee are also included.

REPORT ON TANGANYIKA TERRITORY FOR THE YEAR 1921. H.M. Stationery Office, 1922. Cmd. 1732. Price 6d.

Sisal and coffee of excellent quality are grown in the Tanganyika Territory (formerly part of German East Africa) chiefly by European planters, and the cultivation by natives of groundnuts—for which the conditions are very favourable—is extending. The cotton crop of 1921 was poor, owing to late planting and the ravages of insect pests, whilst the output and quality of copra were unsatisfactory. Lack of transport facilities prevents an extension of agricultural production, but it is proposed to increase the value and decrease the bulk of crops by partial manufacture on the spot. There are several experiment stations and a veterinary laboratory. A survey of the forests has shown the presence of large quantities of valuable timber such as cedar, yellow woods, West African mahogany, mangroves, etc.; a concession has been granted to exploit the Rau Forest (Kilimanjaro area) and tenders have been invited for leases of the mangrove forests.

When the Mining Ordinance came into force in June, 1921, 395 claims were registered for prospecting for gold, silver, diamonds, copper, asbestos, mica, molybdenum, coal, salt, and soda, and exclusive licences were granted to prospect for coal over a total area of 950 sq. miles in four localities.

There are indications of the presence of petroleum, but exploration is forbidden pending the enactment of legislation.

Except the Nyanza (Gottorp) salt mines, which are worked by the railway and supply salt to the Congo, and a small salt factory maintained by the Administration in the south-west area, there are no manufactures of commercial importance in the territory. Soap, ice, soda-water, etc. are made on a small scale for local use, but the produce of the country is exported in a raw state.

In 1921 imports were valued at £1,426,125 and exports at £1,246,870, representing increases of £308,000 and £784,000, respectively, compared with 1920. Among the exports were:—Sisal 7923 tons, cotton 1096 t., hides and skins 356 t., copra 4514 t., groundnuts 8448 t., and beeswax 183 t. The United Kingdom and British possessions supplied imports to the value of £1,381,125 and took 72 per cent. of the exports.

REPORT ON THE ECONOMIC AND FINANCIAL SITUATION OF EGYPT, DATED APRIL, 1922. By E. H. MULOCK, *British Commercial Agent for Egypt, Cairo. Department of Overseas Trade.* Pp. 39. H.M. Stationery Office, 1922. Price 1s.

The financial situation of Egypt on March 31, 1922, was more satisfactory than it was a year previously, in spite of low prices for cotton and general trade depression. The total foreign trade for the calendar year 1921 amounted to only £E. 91,864,046, as compared with £E. 187,348,024 in 1920, exports falling 35 per cent. to £E. 36,356,062, and imports 45 per cent. to £E. 55,507,984. The United Kingdom took 47 per cent. of the exports and the United States 18 per cent., whilst the imports were derived mainly from the United Kingdom 37 per cent., the United States 15, France 7, and Germany 3 per cent. German firms are making great efforts to regain their trade by offering to complete, at pre-war prices, contracts that were made before the war and abandoned, and by other means. Compared with 1920, the total imports from Germany increased by nearly 50 per cent.; those from the United Kingdom fell considerably below 50 per cent. The Leipzig Fair brought German firms much trade, but now that they demand payment in foreign currency, their competition may be less strong. In comparison with the United Kingdom, Germany supplied more glassware, indigotin, coal-tar dyes and paints, but less chinaware and fewer medicinal preparations. Some of the chief classes of imports and exports were evaluated as follows:—

	Imports	Exports
	£E.	
Hides, skins, leather goods	534,665	443,248
Spirits, beverages, oils	3,817,557	238,406
Paper, etc.	998,545	106,801
Stone, earthenware, glassware	1,128,880	5,933
Dyestuffs, tanstuffs, colours	467,233	53,241
Chemicals, medicinal products, perfumery	2,399,716	309,955

In agriculture the area planted to cotton was restricted and the crop much reduced. An extension of the control of sugar importations was advocated on the ground that the 57,000 acres under cane, grown for the refinery, would be reduced by one-half if sugar were imported freely. No progress in the mining and industry was recorded, but active prospecting for petroleum was undertaken in new areas. The Government continued drilling

operations on both sides of the Gulf of Suez and proceeded with the erection of a small refinery. The Anglo-Egyptian Oilfields, Ltd. produced, mainly at Hurgada, 178,284 metric tons of crude petroleum, as against 145,226 t. in 1920. Home production is insufficient to meet requirements and large quantities of petroleum products have to be imported. In consequence of reduced demand the output of manganese ore fell from 77,562 t. in 1920 to 55,065 t. in 1921, but phosphate production rose by 7211 t. to 122,024 t., although the demand was poor and many mines were closed. A small Egyptian firm has begun to make dry colours and mixed paints at Helouan, near Cairo, utilising materials from mines worked by the ancient Egyptians. The firm intends to erect shortly a large factory with a capacity of 20,000 tons of dry colours and 2000 t. of mixed paints per year of 300 days.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for October 26 and November 2)

TARIFF CUSTOMS EXCISE

Australia.—Drawback of the full duty may be allowed on imported ammonium and potassium nitrates used in manufacturing explosives within the Commonwealth when such explosives are exported.

Belgium.—An export licence is no longer required for sugar, syrups and molasses.

Bulgaria.—Information on the new customs tariff can be obtained from the Department of Overseas Trade.

Canada.—Crude groundnut oil for refining for edible purposes is transferred to the list of duty-free goods.

Ceylon.—The text of the revised schedule of import duties is given in the issue for November 2.

Federated Malay States.—All rubber goods manufactured in the F.M.S. are exempted from export duty until September 1, 1927.

Germany.—Increased import duties have been levied on certain kinds of perfumery, wares of soft indiarubber, hollow glassware, and wares of precious metals.

Guatemala.—Import duties have been reimposed on building materials, e.g., cement, fibro-cement, tarred roofing material, galvanised sheets.

New Zealand.—It is proposed to abolish the 25 per cent. *ad valorem* duty on certain goods imported from countries with depreciated currencies and to replace it by an *ad valorem* duty to be determined from time to time. The agreement for reciprocal tariff treatment with Australia has been passed.

Portugal.—Until further notice, agricultural fertilisers may not be imported.

Spain.—The text of the tariff treatment accorded to British goods under the new commercial treaty with Spain is published in the issue for November 2. Among the chief goods affected are coal, earthenware, iron, steel, metals and products thereof, coal-distillation products, paint, varnish, alkali silicates (solid), insecticides, fungicides, soap, glycerin, superphosphate and chemically-prepared phosphatic fertilisers, salts of nickel and cobalt, and rubber tyres.

Trinidad.—Amendments to the import duties affect glass, glassware, cinematograph films, lard, lard substitutes, matches, metals, vegetables, essential and perfumed oils, soap, and paper. In most cases the duties under the British preferential tariff are half those of the general tariff.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Australia ..	Glassware, cellulose products, artificial silks	446
" ..	Galvanised iron, porcelain ware, crockery, glassware	412/7/1*
Belgium ..	Varnish, enamel, colours	456
British India ..	Incandescent nautics (tender for)	†
British India, Burma, Ceylon ..	Heavy chemicals	451
Bulgaria ..	Drugs, graduated measures (tenders for)	9346 F.E./C.C.
Canada ..	Citric and tartaric acids, saccharin	9700/E.1./C.C.
" ..	Steel sheets	9815/E.D./T.C.2
East Africa ..	Fertilisers, insecticides, scientific apparatus	9595/E.D./C.C.
Egypt ..	Wood naphtha, "tierol" (tender for)	9321/F.E./C.P.
Mexico ..	China, earthenware	3934/T.C./M.C.2
Netherlands ..	Tinfol, tinplate	461
" ..	Paper	462
" ..	Tinplate	463
" ..	Pig-iron, steel	483
New Zealand ..	China, earthenware, glassware	469
Norway ..	Chemicals	486
Philippines ..	Glass, glassware, pottery	225/9/F.G./M.C.
Rumania ..	Tinplate, insecticides	487
South Africa ..	China, earthenware	453
" ..	Tinplate	454
Yugoslavia ..	Earthenware, china	488

* High Commissioner for Australia, Australia House, Strand, W.C. 2
† Director-General, India Store Dept., Branch No. 10, Lambeth, S.E. 1.

GOVERNMENT ORDERS AND NOTICES

SAFEGUARDING OF INDUSTRIES ACT. Part I.—The Board of Trade has received a complaint that "Sodium phosphate, mono-, R. Sodium phosphate, di-, and R. Sodium phosphate, tri-," have been improperly included in the lists of articles dutiable under the Act. (The prefix R was added to the item "Sodium phosphate, tri-" on April 6, 1922.) A further complaint has been received in respect of "sodium phosphate," and the complainants have notified their intention to object to the inclusion of other listed items, such as sodium pyrophosphate. As this complaint goes outside the precise terms of the list, the Board will contend that the only valid complaints received by it are those relating to mono-, di- and tri-sodium phosphate. The complaint will be submitted to the Referee, and interested persons should communicate immediately with the Assistant Secretary, Board of Trade, Great George Street, London, S.W. 1.

REVIEWS

LES PROGRÈS DE LA MÉTALLURGIE DU CUIVRE. By AUGUSTE CONDUCHÉ, *Professor in the Faculty of Science at Rennes. Encyclopédie Léauté. Pp. xii+271. Paris: Masson et Cie., and Gauthier Villars et Cie., 1922. Price 14 francs.*

This little book attempts to give not only a scientific description of the metallurgy of copper, and of the chemical reactions which come into play, but also a summary of recent progress, and of the appliances and installations employed. Its scope may be judged by the fact that no less than 76 pages, nearly one-third of the whole book, are devoted to a description of the properties of copper, its compounds and alloys, 15 to roasting copper ores, 27 to blast-furnace smelting, including pyritic smelting, 10 to reverberatory smelting, 49 to matte-treatment (including converting), 30 to the treatment of complex ores and wet processes, 12 to fire-refining, and 27 to electrolytic refining.

The standpoint of the author throughout is theoretical, reactions are as a rule very well described and equations correctly given, but the descriptions of the appliances and of the operations followed are alike weak; such details, for instance, as the fuel consumption in various operations, the percentages of copper in mattes and slags, and the relative weights of each material produced are usually lacking, whilst data of cost are conspicuously absent.

It is a fact often lost sight of that there are two Metallurgies, the one a science, the other an art. The Science of Metallurgy is only a specialised branch of applied chemistry, concerned with the properties of metals and their alloys, their preparation by various methods, and the way in which the properties of both are modified by the presence of impurities, by heat treatment, etc. Investigation of these points often leads to commercial results of the highest importance, yet in its essence the science of metallurgy is a branch of pure science. Contrasting with this, the Art of Metallurgy may be defined as the "art of extracting metals from their ores and utilising them in such a manner as to yield the maximum of profit." The science of metallurgy is well dealt with by the academic professor, who in the investigation and recording of facts finds himself upon surer ground. With the art of metallurgy, the professor is too often not only out of touch, on account of his purely superficial knowledge and his ignorance of the essential details of operation and of manipulation, which can only be acquired by long experience, but frequently also out of sympathy, because these details, being dependent upon many variable factors, cannot be reduced to exact figures or tabulated, as can chemical or physical data. The present work exemplifies in characteristic fashion the limitations of the theoretical man in describing processes with which he is familiar only through his study of current literature. The chapter on blast-furnace, pyritic, and reverberatory smelting are all weak from the point of view of practical detail, and contain many statements which are either very incomplete or actually incorrect.

The author revives, for instance (p. 102), the old fallacy and bugbear of the theoretical man that "slags too rich in iron may give rise to the production of iron bears"; whereas experience proves

that iron bears are never formed where there is plenty of iron to give a fusible slag and fast running; their formation is due to deficiency of iron and excess of silica, alumina, or lime, which gives rise to a high temperature of formation and slow running.

In order to ascertain the depth of matte in a settler, it is hardly necessary (as stated on p. 111) to "plunge into it a bar of red-hot iron," (!) and then note that after withdrawal "thanks to the greater conductivity of the matte, the part of the bar plunged therein takes a tint visibly darker than that which was exposed to the layer of slag." The ordinary well-known method of plunging in a slightly warmed bar and withdrawing after a few seconds shows clearly the level of the matte bath by a crust of congealed slag adhering to the bar above that level and a nearly clean red-hot bar below, corresponding to the depth of the bath of matte. The author describes (p. 112) the discharge of molten slag from a settler as taking place "periodically," by which is meant "intermittently." Such practice must be altogether unusual in copper smelting, if not unique, although intermittent tapping of lead slags from large reverberatory settlers is frequently adopted. In describing the practice at Anaconda the author states, on p. 116, that the slags at the Washoe smelter formerly contained lime and ferrous oxide in the molecular ratio of 2:1. This was never the case, and the statement gives a misleading impression; the highest average percentage of time in the slag was about 26 per cent., as against 22–23 per cent. FeO , which, in molecules, is only as 1.5:1.

The chapter on converting is perhaps the best in the book and presents fewest blemishes. At the top of p. 151, however, with reference to casting the converter copper in moulds, the author says "care being often (sic) taken to leave in the converter the rich slag which will serve during the following operation"; it may be remarked that, provided the slagging after blowing to white metal has been properly done, there will be very little slag left at the end of the blow, and what little there is generally accumulates near the mouth of the converter, from which it has to be clipped off after the operation of casting is completed.

Perhaps the weakest chapter of the book is that dealing with wet methods. No mention is made of the leaching of sulphates at Chuquicamata or of the ammonia leaching process, which, after having been discarded several times on account of operating details, has scored a marked success in Arizona, and is now to be adopted on a large scale in Central Africa. The description of the Huerva cementation process is by no means good. In explaining the oxidation of pyrites, for instance, the author says that in presence of air and of water, ferric sulphate and sulphuric acid are formed, whereas it is well-known that in the presence of a moderate amount of moisture ferrous sulphate is formed directly, and ferric sulphate only forms through a further absorption of oxygen in dilute solution.

The chapter on electrolytic refining is quite a good outline from the theoretical point of view, although, as usual, lacking in detail as regards the appliances employed and the operations carried out.

To sum up, it may be said that although too sketchy to be of use to practitioners of the art of copper metallurgy, the book will form a useful outline of modern practice from the point of view of the comparatively elementary student of the

subject, for whom it is obviously intended; and it may even be of some use to those practically engaged in other branches of metallurgy, as throwing some sidelights upon their own work.

H. F. COLLINS.

PRACTICAL TANNING. *A handbook of modern practice and processes as applied in the manufacture of leather and allied products.* By DR. ALLEN ROGERS. Pp. xxx.+699. London: Crosby Lockwood and Son, 1922. Price 45s. net.

This work is based upon earlier editions bearing the same title, written by Louis A. Flemming. It has been modernised by the contributions of Dr. Rogers and his associates, and by the inclusion of a considerable amount of matter from other sources. The various processes of leather manufacture are ably dealt with in a style that will commend the volume to most practical men. The articles upon Unusual Tanning Processes by the author, Pigment Finishes by C. B. Kinney, and Patent Leather by G. W. Priest contain much interesting information, and as each has special knowledge of his particular subject, the contributions are of distinct value. The book contains many original illustrations, the subject matter is well arranged, and is reasonably free from typographical errors, and the detailed table of contents affords a ready means of access to any desired information. The British reader should remember that the American gallon is roughly 17 per cent. smaller than the English gallon.

Dr. Rogers is aware of possible differences of opinion on some of the topics with which he deals, but it is not appropriate to discuss them here. At the same time, certain erroneous statements are made which call for comment. The assertion (page 496) that whilst sulphuric acid plumps hide, hydrochloric acid in certain dilutions has a depleting action, is contrary to fact. Various investigators have shown that under similar conditions the latter has even a greater swelling effect than the former. Dealing with the depickling of sheepskins, two working methods are suggested: (a) treatment with sodium bicarbonate—salt solution, and (b) a sour drench of bran and salt. The former is quite rational, but it is not apparent why a sour (i.e., acid) drench is suggested as an alternative to the alkaline solution, and a simple brine solution would appear to be more effective for the purpose intended.

The Glossary of Terms used in the industry contains many errors and some superfluous definitions. Thus "depleting action" is referred to as "any action which tends to loosen the hair and epidermis," whereas in tannery usage it has no different meaning from that suggested by an ordinary dictionary definition. Similarly "tan" is wrongly defined as "any material which will prevent the putrefaction of hide substance." Common salt and all raw-hide preservatives would be classed as tanning agents according to the glossary. It is surely unnecessary to inform the reader that a lamb is a young sheep, and a kid a small goat! In its present form the glossary might have been omitted with advantage.

As a whole, the book is of distinct value to the practical tanner, as it contains much helpful information, but some assertions must be accepted with a certain amount of reserve.

DOUGLAS McCANDLEISH.

DIE METHODEN ZUR HERSTELLUNG KOLLOIDER LÖSUNGEN ANORGANISCHER STOFFE. By Dr. THE SVEDBERG. *Third edition.* Pp. xii.+507. *Dresden and Leipzig: Theodor Steinkopff, 1922.* Price 14s., bound.

The issue of this new edition, an unaltered reprint of the second edition, of Svedberg's well-known work, testifies to its continued usefulness and value. From the comparatively small dimensions of the first edition the work has now grown into quite a large volume, in harmony with the general expansion which has taken place in the study of the colloidal state. In this volume, the author brings together most usefully the different methods which have been employed for the production of the colloidal form of different substances, and has thereby rendered a great service to other workers in this department of study and investigation. The methods for producing the colloidal state fall naturally into two groups, condensation methods and dispersion methods. In the former group one has, for example, methods depending on reduction, oxidation, and hydrolysis; whilst in the second group peptisation and electrical-dispersion methods find their place. The book is well written, the descriptions of preparations are clear, and full references to the original literature are given. The work is one which every worker in the domain of colloid chemistry will find indispensable.

ALEX. FINDLAY.

LABORATORY MANUAL OF COLLOID CHEMISTRY. By H. N. HOLMES, *Professor of Chemistry in Oberlin College.* New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922. Price 10s. net.

The book before us is one which will be welcomed by every university teacher of chemistry who desires to introduce his students to the study of the colloidal state of matter. The rapid extension of chemistry in various directions has made it necessary to supplement the old courses in practical chemistry, consisting of inorganic analysis and organic preparations, with experiments in physical chemistry, electrochemistry, etc. And so the importance, from the practical point of view at least, of the study of the colloidal state is making it necessary to supplement the lectures on colloid chemistry, which must form a part of every honours course, by work in the laboratory. The work of organising and carrying through such a course will be greatly helped by the book which Prof. Holmes has written at the request of the Colloid Committee of the National Research Council of the United States. The experiments described by the author cover a very wide range and give scope for selection on the part of the teacher. In this selection, the teacher is helped by the author, who has suggested courses for medical students, students of agriculture or ceramics, students of geology, and students of industrial chemistry, as well as a general course to meet the needs of the student of pure chemistry. The value of the book is greatly increased by references to the literature and suggestions for collateral reading. The work is excellent and will, it is hoped, facilitate the introduction into our university courses of practical instruction in colloid chemistry.

ALEX. FINDLAY.

OBITUARY

ALEXANDER CRUM BROWN

By the death of Emeritus Professor Alexander Crum Brown, at his residence in Edinburgh on October 28, at the ripe age of eighty-four, chemistry in Britain loses one of the most noteworthy figures of a passing generation, and a wide circle of scientists and others privileged to know him loses one of the most warmly esteemed of friends. Born in Edinburgh in 1838, he received his school education at the Royal High School there, and at Mill Hill. He then became a student at Edinburgh University, where, at the age of twenty, he graduated as M.A., and three years later, in 1861, as M.D. In the following year he obtained the degree of D.Sc. from the University of London. At an early age he seems to have been specially attracted to chemistry, most probably having had his attention turned in that direction through the circumstance of his maternal uncle, Walter Crum, himself a noted chemist, being engaged in chemical industry in the west of Scotland. At any rate, his M.D. thesis was a purely chemical one. After obtaining his medical and science degrees in Britain, he spent a year in Germany, where he made many life-long chemical friends, and where the work for his first published chemical paper, on the conversion of mucic acid into adipic acid, was carried out. A speculative vein with respect to theoretical chemical conceptions, which more or less distinctly characterised most of his subsequent contributions to chemistry, was evidenced in his M.D. thesis "On the Theory of Chemical Combination." At the date of its presentation, this thesis contained much that was in advance of the time, and, moreover, it foreshadowed a feature which became markedly noticeable in his later writings and in his dealings with affairs; that is, a far-seeing anticipation of the direction in which further investigation was likely to lead, and of the eventual consequences which would result from some line of action.

The speculative aspect of Crum Brown's mind and his strong liking for theoretical matters are well illustrated by a consideration of the diverse chemical subjects which engaged his particular attention, and by an examination of his treatment of these subjects in his original memoirs. In these connexions his papers or addresses on the theory of isomeric compounds, on the phlogiston theory, on chemical constitution and graphic formulæ, on the basicity of acids, on solution and osmotic pressure, on the ions of electrolysis, on the Le Bel—van't Hoff hypothesis, and (in conjunction with the late Sir Thomas R. Fraser) on the connexion between chemical constitution and physiological action may be recalled, and there are none of these subjects to which he did not contribute something of real and permanent value, either by experiment or by suggestion. The Crum Brown—Gibson rule concerning the position taken by replacing groups entering mono-substituted benzene derivatives also deserves mention here. In addition to the subjects just mentioned, Crum Brown, either alone, while occupying the chair of chemistry in Edinburgh University, to which he was elected in 1869, or in collaboration with pupils or assistants (Letts, Walker, and others) carried out investigations on the rusting of iron, on trimethylsulphine and

thetine compounds, on the electrolytic synthesis of dibasic organic acids, and on a variety of minor subjects, all the time maintaining a remarkable flow of new and ingenious devices for attacking unsolved chemical problems.

Besides his pre-eminent position as a chemist, Crum Brown was a versatile philosopher, widely-read in other scientific subjects, including mineralogy, crystallography, and physiology, as well as in general literature; he was, also, a linguist of unusual attainments. Of the charm of his alert, vivacious personality as a host, as a *raconteur*, as a man, much might be written by one who held a sufficiently gifted pen. Failing the latter, it must suffice to quote one illustration of the man speaking for himself, as he did in the concluding words of his opening address to the Royal Medical Society in 1896:—

"Gentlemen, there are some things you need which cannot be got in lecture-rooms or laboratories, in dissecting rooms or in museums. I do not now refer to the priceless treasures, Honesty, Truth, Courage, Modesty, Kindliness, all that we include in our idea of a noble and good man; we should all covet earnestly these gifts and seek to increase more and more in them. I speak now of attainments of a more special sort—the power of easy and accurate expression, the power of quickly and correctly grasping ideas expressed—perhaps not very well expressed—by others . . . These things can be had here. 'Iron sharpeneth iron; so a man sharpeneth the countenance of his friend.' And friends here learn to sharpen each other's wits without ceasing to be friends. We learn here to give and to take pretty outspoken criticism without any fear of taking or giving offence. I am speaking in the presence of many who know all this as well as I do, of many who could speak the praises of the Society far more forcibly and far more effectively than I; but I do not think there is anywhere any one who could do it more heartily."

LEONARD DOBBIN.

PUBLICATIONS RECEIVED

THE THEORY OF ALLOTROPY. By DR. A. SMITS. Translated from the German by DR. J. SMEATH. *Text-books of Physical Chemistry*, edited by Sir W. Ramsay and Prof. F. G. Donnan. Pp. 397. London: Longmans, Green and Co., 1922. Price 21s.

RAPPORT SUR LE COMMERCE ET L'INDUSTRIE DE LA SUISSE EN 1921. Pp. 438. Zürich: Secrétariat de l'Union Suisse du Commerce et de l'Industrie. Price 9 francs.

THE NITROGEN INDUSTRY. By PROF. J. R. PARTINGTON and DR. L. H. PARKER. Pp. 336. London: Constable and Co., Ltd., 1922. Price 21s.

CHEMICAL REACTIONS AND THEIR EQUATIONS. By PROF. I. W. D. HACKH. Pp. 138. London: Chapman and Hall, Ltd., 1922. Price 6s.

SENSITOMETRY OF PHOTOGRAPHIC EMULSIONS AND A SURVEY OF THE CHARACTERISTICS OF PLATES AND FILMS OF AMERICAN MANUFACTURE. By R. DAVIS and F. W. WALTERS, JR. United States Bureau of Standards. No. 439. Washington: Government Printing Office, 1922. Price 35 cents.

LEIM UND GELATINE. By DR. L. THIELE. Second edition, revised. Pp. 189. Leipzig: Max Jänecke, 1922. Price, paper, 4s.

HEAT TRANSMISSION. TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918. Ministry of Munitions and Department of Scientific and Industrial Research. No. 9. Pp. 48. H.M. Stationery Office, 1922. Price 5s.

COAL: A SERIES OF LECTURES ON COAL AND ITS UTILISATION. Delivered in the Department of Fuel Technology, Sheffield University, by H. CHAMBERLAIN, J. W. COBB, R. LESSING, F. S. SINNATT, and M. C. STOPES. Pp. 41. London: Colliery Guardian Co., Ltd., 1922. Price 5s.

IRON ORE. PART VI.—EUROPE AND AFRICA (FOREIGN). SUMMARY OF INFORMATION AS TO THE RECENT AND PROSPECTIVE IRON-ORE SUPPLIES OF THE WORLD. Imperial Mineral Resources Bureau. Pp. 275. H.M. Stationery Office, 1922. Price 6s.

STANDARD SPECIFICATIONS FOR LABORATORY APPARATUS ADOPTED BY THE MANUFACTURING CHEMISTS' ASSOCIATION OF THE UNITED STATES. PART I.—GRADUATES AND THERMOMETERS. Pp. 49. Published by the Association, Washington, D.C., 1922.

PROCEEDINGS OF THE TECHNICAL SECTION OF THE PAPERMAKERS' ASSOCIATION OF GREAT BRITAIN AND IRELAND. Vol. III. Part 1. October, 1922. Published by the Association, 26, Farringdon Street, E.C. 4. Price 10s. 6d.

(1) DEFINITION OF RELATIVITY. Pp. 16. (2) DEFINITION OF THE AETHER. Pp. 16. (3) DEFINITION OF EQUIVALENCE. Pp. 16. (4) DEFINITION OF ISOTOPES. Pp. 20. By F. H. LORING. *Science by Definition Series*. London: H. O. Lloyd and Co., Ltd., 1922. Price 1s. each.

MINERALS AND MINING INDUSTRIES ON THE CANADIAN NATIONAL RAILWAYS. By C. PRICE-GREEN. Pp. 63. Toronto: Industrial and Resources Department, Canadian National Railways, 1922.

BULLETINS OF INDIAN INDUSTRIES AND LABOUR. Calcutta: Superintendent, Government Printing, India, 1922:—

PROCEEDINGS OF THE FOURTH CONFERENCE OF DEPARTMENTS OF INDUSTRIES. No. 27. Price 1 rupee.

NOTES ON SULPHURIC ACID, SULPHUR, AND IRON PYRITES. By C. S. FOX. No 28. Price 6 annas.

PUBLICATIONS OF THE UNITED STATES' BUREAU OF MINES. Department of the Interior. Washington: Government Printing Office, 1922:—

FACTORS IN THE SPONTANEOUS COMBUSTION OF COAL. By O. P. HOOD. Tech. Paper 311. Price 5 cents.

SAFE MECHANICAL EQUIPMENT FOR USE IN SHAFT SINKING. By R. H. KUDLICH. Tech. Paper 276. Price 5 cents.

APPLICATION OF THE GEOPHONE TO MINING OPERATIONS. By A. LEIGHTON. Tech. Paper 277. Price 10 cents.

PERMISSIBLE EXPLOSIVES, MINING EQUIPMENT, AND APPARATUS, APPROVED PRIOR TO MARCH 15, 1922. By S. P. HOWELL, L. C. ILSLEY, D. J. PARKER, and A. C. FIELDNER. Tech. Paper 307. Price 5 cents.

REVIEW

Vol. XLI]

NOVEMBER 30, 1922

[No. 22

UNVEILING OF THE WAR MEMORIAL TO LT.-COL. HARRISON AND OTHER FELLOWS OF THE CHEMICAL SOCIETY

ON November 16, in Burlington House, London, a large number of Fellows of the Chemical Society and many representatives of other scientific societies attended the unveiling of the War Memorial to Lieutenant-Colonel E. F. Harrison and other Fellows by the Rt. Hon. the Earl of Crawford and Balcarres. The memorial, executed by Mr. E. Gillick, consists of a large bronze medallion depicting a trench scene at the moment of the approach of a gas cloud; the medallion is mounted on a slab of Italian (Lamartine) marble and below it are inscribed the names of thirty other Fellows who gave their lives for their country during the Great War. The memorial is erected on the south wall of the landing on the first floor in the Chemical Society's rooms.

Sir James Walker, president of the Chemical Society, presided, and Sir George Beilby, chairman of the Harrison Memorial Committee, made a statement concerning the origin and destination of the memorial fund. To that fund, he said, £1640 had been subscribed, and the committee had decided to use a portion of it for the erection of a permanent memorial, and to devote the remainder to the provision of a prize of approximately £150, to be awarded every three years to the chemist, man or woman, not above thirty years of age, who had made the most meritorious original contributions to chemical science during the preceding five years. The prize would be awarded upon the recommendation of a committee comprising the presidents of the Chemical Society, the Society of Chemical Industry, the Institute of Chemistry, and the Pharmaceutical Society. He asked Sir James Walker to accept, on behalf of the Chemical Society, the custody of the memorial and of the trust deeds of the fund.

In accepting the trust, Sir J. Walker remarked that the institution of the prize would commend itself to all as a most wise election. A capable investigator at the outset of his career was adequately provided for by scholarships, etc., and late in life he generally had received, indirectly for the most part, some reward for

his work, but there was a period when the substantial encouragement of such a prize would prove a determining factor in his development.

The Earl of Crawford and Balcarres then delivered an address in which he referred to the sadness of such occasions, when the closed book was reopened, and to the compensation and comfort brought to those who mourned by the acknowledgment of heroism and public service, and the recognition of exceptional skill and distinction. He congratulated the committee and the Society on having chosen a sculptor of note, on having placed at his disposal an admirable site, and on having given him full freedom to develop his idea. In eloquent phrases he recalled Colonel Harrison's great achievement in combating "the most terrible assaults ever directed by science against an army in the field," and then passed to an appreciation of his character. Harrison had the power of concentrating the accidents of knowledge and intelligence and of directing them into a consistent and specific channel. He had the power of interrogation, combined with intuition, which enabled him to anticipate developments and thus meet in good time the progress of enemy attack. Honour was also due to the other Fellows of the Society whose names were recorded on the memorial: men of conspicuous ability in their own departments of research, men of character and promise, whose precious lives were ended prematurely. Among these was Andrea Angel, who died in January, 1917, in the disaster at Silvertown, where he returned into a blazing building, knowing it to contain people in danger of their lives, and so perished.

Lord Crawford then unveiled the memorial; "The Last Post" was sounded; there was one minute of silence; and "The Reveille" announced the completion of the ceremony.

In a few words Sir James Walker thanked Lord Crawford for performing the ceremony and for his address, and reminded those present that he (Lord Crawford) was an artist and writer on sculpture, well fitted to judge the artistic merit of the memorial; and that he

had enlisted as a private in the Royal Army Medical Corps, and so had witnessed the ravages of poison gas and the success of the protective measures employed against it.

A photograph of the memorial is reproduced on the art inset; opposite to it is a similar reproduction of the Ramsay Memorial, which was described in our last issue.

ANTICORROSIVE AND ANTIFOULING COMPOSITIONS

P. E. BOWLES

THE advent of the iron ship, with all the great improvements it made in shipping conditions, brought in its wake to a very serious degree the troubles of corrosion and fouling. By "fouling" is meant the accumulation of marine growth, which often assumes incredible proportions. The writer has seen weed-growths two feet in length on a vessel, coated with inferior compositions, which had been riding at anchor in home waters for six months. One can imagine, then, what the appearance of an unprotected ship's bottom would be like after a twelve-months' voyage in tropical seas!

The problems of corrosion and fouling soon demanded the urgent attention of the entire shipping industry, and so serious was the subject that Admiralty experts were at one time quite prepared to condemn the use of iron ships as men-of-war because of their weakness in these respects. In a report dated 1863 the Controller of the Navy gave as one of the reasons why he preferred wooden ships: "The rapidity with which the bottom of an iron ship gets foul, and the immense loss of all the ship's qualities that follows from the adhesion of marine zoophytes. No practical remedy has been found for this serious disadvantage; repeated docking and cleaning is the only palliative."

It is unnecessary to argue at this present period the case of Wood v. Iron for shipbuilding, but it is interesting to note that the Admiralty aimed very high when it considered a composition to have failed which did not keep a ship's bottom clean during the whole time of her commission, say from three to five years! This ideal has never been approached, and if one dared to play the rôle of prophet it might be stated that such immunity never will be realised. Modern metallurgy may succeed in rendering ships free from corrosion, but it is almost inconceivable that a permanent force ready to do battle against the myriads of marine organisms, fighting in their native element, and itself suffering no wastage, should ever be discovered. At the same time modern ships' compositions have played an enormous part in keeping the iron fleets of the world at sea and the units of those fleets in an efficient condition.

The modern accepted practice, which experience has proved to be right, is that the ship must primarily be protected from corrosion. All

of the antifouling compositions in general use contain constituents which, in the presence of sea water, induce corrosion, so, in addition to the corrosive action of the sea water on iron itself, one has to protect the ship from the corrosive effect of the antifouling composition.

The ideals to be sought after, then, in making an anticorrosive paint are that:—

(a) It should be waterproof, as only by excluding the water from iron can corrosion be prevented.

(b) It should remain entirely undisturbed on the application of the coat of antifouling composition; failure in this respect is referred to in the dockyards as "lifting" or "breaking through."

These conditions would be comparatively simple to fulfil if it were not for the fact that modern dry-dock practice demands compositions which dry very rapidly. The most waterproof varnishes are those made from linseed oil and linseed oil containing gums, resins, etc. Oil-varnishes dry by oxidation, and their use is absolutely barred on account of the time taken in drying. "Dry dock" is a courtesy title, as most dry docks are dripping wet, the air laden with moisture and the ship's sides "sweating." Under these circumstances many days would probably be required before a linseed-oil varnish would dry. Ships' compositions must, therefore, dry, not by oxidation, but merely by loss of solvent. Since this remark applies also to the antifouling coat, which also contains solvents, the difficulty of making a priming coat that will dry rapidly and be unaffected by the solvents of the second coat will be readily appreciated. As already stated, the finishing coat is invariably one which induces corrosion, consequently one must condemn unhesitatingly any compositions which show signs of breaking through, and, moreover, view them with grave suspicion if the priming and second coats are of approximately the same colour, thus tending to mask the breaking through.

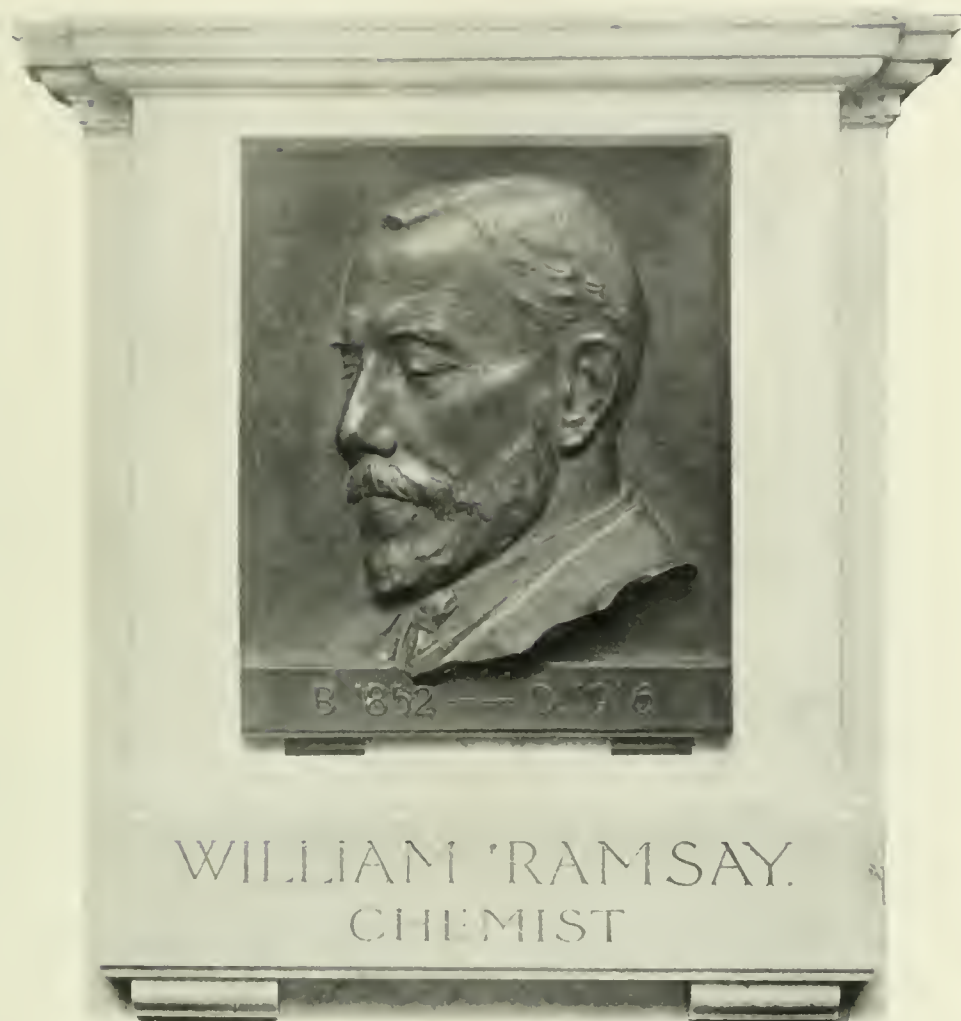
The difficulty can be overcome by using dissimilar solvents for the two compositions and employing as the base of the priming coat materials that are not brought into solution again by the solvents in the antifouling compositions.

Certain gums, gum mixtures, resins—sometimes in simple solutions, sometimes hardened

492' R



Memorial to Lt.-Col. E. F. Harrison and other Fellows of the Chemical Society, erected in the Society's rooms, and unveiled by the Rt. Hon. the Earl of Crawford and Balcarres, on November 16, 1922.



Elliott and Fry

by partial neutralisation with lime—are commonly used as a vehicle, and iron oxide as a pigment, together with, in low-grade anti-corrosive paints, some cheap inert filler. This would be thinned down with naphtha or some similar solvent that evaporates rapidly. Shellac solutions are excellent for forming hard water-proof films, but the high price of the material, together with the fact that methylated spirit is used as a solvent, has driven them out of the market.

By far the most satisfactory products, however—those which meet the requirements very well from all points of view—are certain pitches and asphalt solutions. By blending asphalts with pitches a mixture can be obtained which satisfies the conditions required. Moreover, since such solutions dry very rapidly, a small quantity of linseed oil can be incorporated, lending a desirable toughness to the film without unduly hindering the drying. Much patient research was required before the right blend could be found, and the composition, as well as the method of manufacture, is a secret jealously guarded by the manufacturers. The pigment used in these asphalt primings, like the others, is iron oxide, and the solvent is tar oil. The colour is naturally very dark, and would show very readily through the coat of antifouling composition should any lifting occur.

Having now protected the vessel against corrosion, the equally important question of preventing the accumulation of marine life comes up for consideration. The reduction in knots of a high speed ship, even when only slightly foul, is very great, and to counteract it entails an enormous extra expense in coal.

A glance at the photograph (Fig. 1)



FIG. 1

makes this easily realisable. This shows a sheet of iron which, after being coated over all with an anticorrosive paint, was then coated on different sections with six experimental patches of antifouling compositions. The top left-

hand strip was given only the priming and no antifouling coat. The plate was immersed in Genoa harbour for two or three months, and shows the capability of compositions to resist fouling. The second patch has entirely failed, being as foul as the strip at the top left half, which has no antifouling composition at all. Had a ship been coated with this composition its speed would have decreased very rapidly.

The object of the antifouling composition is to surround the ship with a solution which is toxic to both animal and vegetable marine organisms, so that these are destroyed whilst still of microscopic size. There was at one time a theory that ships might be kept free from fouling matter by the gradual disintegration of the composition, so that the organism could only obtain a very insecure foothold, which would be even less secure the larger it became. This "exfoliation" theory had at one time many adherents, but the fact remains that, so far as the writer is aware, no successful antifouling composition has been prepared which is free from poisonous substances.

Bearing in mind the remarks already made with regard to quick drying and "non-lifting" of the priming coat, the problem resolves itself into one of designing a composition containing toxic materials which will dissolve slowly in sea water, and thus maintain a strongly antiseptic film surrounding the ship. Obviously, then, the choice of a suitable vehicle or varnish is of outstanding importance. If it is too impervious to moisture the sea water cannot dissolve the poisonous substances, which then for all practical purposes might as well be absent; if, on the other hand, the varnish does not hinder the solvent action of the sea water, the composition loses its toxicity too rapidly, and although the composition may be good in other respects, as an antifouling medium it has ceased to function. One can consider the varnish of a composition when painted out to be in the nature of a honeycomb, the tiny hollows of which are filled with pigments and poisons. If the poisons are of such a character that they are only very slightly soluble, then a large-mesh honeycomb is desirable so as to allow free access of the sea water; if the poisons are readily soluble, then the honeycomb should be made as small as possible. With this purely pictorial idea in the mind it is easy to see that the temperature, *i.e.*, the latitude in which a ship is steaming, plays an enormous part. A composition which might prove highly successful in the North Atlantic would be almost worthless in tropical waters. Since the majority of steamers trade in all quarters of the globe, the paint manufacturer must perforce content himself with attempting to meet average conditions.

Ordinary antifouling compositions nearly always have iron oxide for a pigment, which in the better class is always of a high quality, imparting to the paint the brilliant red so

beloved by dock officials, to whom, of course, the artistic effect should be a matter of supreme indifference, since the primary function of the composition is to prevent fouling.

The question of settling of the paint presented some difficulty to the earlier manufacturers, but has been largely overcome by the use of better ground pigments made possible by the superior machinery which the modern manufacturer has at his disposal.

Almost every conceivable type of gum and resin is used by different makers in their efforts to arrive at an ideal varnish. Amongst others may be mentioned resin, copal, dammar gum, Borneo gum, and artificial resins of the type of coumarone resin; but this short list might be considerably extended.

Of the bodies used to render the compositions toxic, salts or compounds of copper and mercury are of first importance; arsenic compounds come next.

The copper in red compositions is usually in the form of cuprous oxide, which, by being carefully precipitated, can be obtained as a permanent, brilliant dark-red powder; this, when used in conjunction with iron oxide, imparts to the composition an attractive appearance. It is the gradual solution of this material which is responsible for keeping the vessel surrounded with a skin of antiseptic sea water, and is inhibitive to the growth of marine organisms, more particularly those belonging to the vegetable kingdom. Cuprous oxide is also made electrolytically, but experience has shown that this is somewhat inferior in antifouling properties to that prepared by the precipitation method, and at the same time more likely to induce corrosion, probably owing to the small quantity of metallic copper which it invariably contains. Where a red composition is undesirable, *e.g.*, for submarines, other salts of copper are used; but, of course, only those which have a low degree of solubility, such as emerald green, $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{Cu}(\text{AsO}_2)_2$, copper carbonate, copper thiocyanate and, rarely copper cyanide. These are usually employed with zinc oxide, as a base or pigment, which itself is mildly antifouling. Yellow hydrated cuprous oxide is also used to a small extent. Copper has been introduced in many other forms in organic combination, of which copper resinate, oleate, stearate may be quoted as typical examples. In practice the free acidity is neutralised, entirely or partly, with some suitable copper compound and the resultant product incorporated in the vehicle of the antifouling composition.

Mercury is usually added to the composition in the form of oxide or sulphide. Sometimes also mercurous chloride is used, but superior results have been consistently obtained from the use of organic compounds. By this means a given quantity of mercury can be spread over a larger area, owing to the small percentage of

mercury in the organic compound. For instance, mercuric dinaphthyl, with a molecular weight of 454, will enable, other things being equal, a given weight of mercury to be spread over a far larger area than if the same weight of mercury were in the form of, say, the oxide. The high cost of mercury prevents its being used lavishly on a commercial scale; and this makes the preparation of organic compounds advisable. It is an unfortunate fact that no cheap and efficient substitute for mercury has been found. From the shipowner's point of view, however, in the long run it is still more costly to use compositions which do not contain mercury.

Unfortunately, arsenic, although used by some manufacturers, appears to be of very little use unless in combination with copper, as in emerald green. One would anticipate from a knowledge of the properties of arsenic oxide and arsenious oxide that either one or the other, or a judicious mixture of both, would be a suitable poison for antifouling compositions; but anyone who has experimented with these materials would soon part with any preconceived optimism. In the writer's opinion, they are practically useless.

In this short article it is neither desirable nor possible to deal with the great variety of materials which has been pressed into the service. Nor can the problem of keeping ships' bottoms free from corrosion and fouling be considered settled; at the same time, however, good-quality compositions have achieved much, and shipowners can feel that under normal trading their vessels' bottoms will be kept in a reasonably good condition for periods of from nine to twelve months.

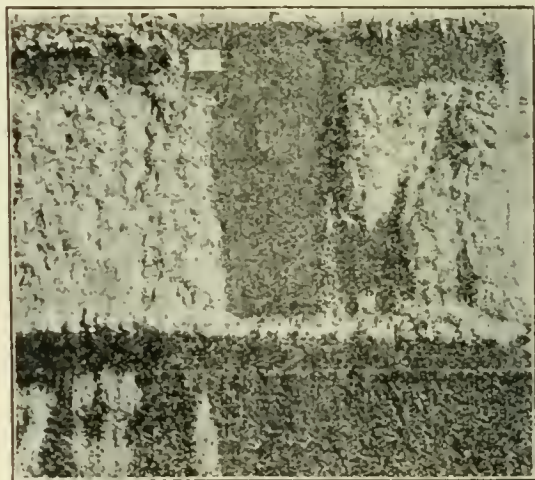


FIG. 2.

The annexed photographs show more experimental plates and demonstrate how cautious one must be in predicting the effect of materials when in the form of compositions. All these experiments were designed as improvements on

a well-known standard brand, which was painted right across the top in Fig. 2 and the top right-hand strip in Fig. 3. Actual trial, which is the only reliable test, has shown the modifications to be wrong. Only by this process of elimination can the best results be achieved. As in actual practice most vessels are in dry dock on the average at least once in twelve months for purposes other than painting, the manufacturer of modern compositions can



FIG. 3.

claim to have kept pace with the naval architect, for whilst in dry dock it would be folly to float a vessel again without seizing the opportunity to give her fresh coats of composition.

EMIL FISCHER'S RECOLLECTIONS

SIR WILLIAM J. POPE

AT the time of his death, on July 14, 1919, in his 67th year, Emil Fischer was the most universally respected figure in chemical science. He exercised a great personal influence over his students, he had written his name large on many chapters in pure and applied chemistry, and he was recognised by all as an honest, straightforward man who had done much to enhance the status of his science.

Whilst excellent biographical notices of Fischer's life and work have been published, such as those by M. O. Forster (*Trans. Chem. Soc.*, 1920, 117, 1157) and Kurt Hoesch (*Berichte, Sonderheft*, 1921), the knowledge that an autobiography was in existence still aroused keen interest. This autobiography has been published recently as "*Aus meinem Leben*,"* and a few copies have reached this country. Recognising the intense scientific and academic interest of the period covered by Fischer's

active life, most chemists had anticipated that this work would appeal to them in the same way that Hofmann's "*Zur Erinnerung an vorangegangene Freunde*" appealed to a former generation of chemists; in this expectation they will be disappointed. Fischer's personal narrative is so entirely unworthy of the position which he occupied in science that its publication will bring a sad disillusionment to many.

Most chemists have probably pictured Fischer to themselves as a man of uncommon intellectual gifts—which he certainly was—and of the wide general interests which we ordinarily associate with the possession of such gifts. One would have anticipated that so undisputed a leader in chemistry as Emil Fischer would have been keenly interested not only in all scientific subjects but also in the humanities and in the great world-movements of which he was a witness. "*Aus meinem Leben*" shows clearly that, apart from his interest as a specialist in organic chemistry, Fischer was oblivious to everything save the most casual happenings connected with those with whom he came into daily contact.

This little volume of 200 pages was written whilst its author was in convalescence at Carlsbad and Locarno. It opens with the enumeration of countless relatives concerning the majority of whom only trivial details are recorded; it is difficult to believe that any person with a well-stored mind could pass two periods of repose away from home at the age of 66 extracting this vast amount of casual knowledge from the recesses of his mind and rigidly suppressing all his greater experiences. Fischer refers frequently to his indulgences in beer-drinking and tobacco-smoking, and suggests in a veiled kind of way that immoderation in these pursuits may possibly have been responsible for his later bodily infirmities. One joyous evening convinced him, he tells us, that nothing in the world compares with beer as a solvent for official and social distinctions and for establishing equality among human beings. Amongst his other simple pleasures he mentions music, but says nothing to indicate that he regarded this art as other than a distraction of the same order as his card-playing. Fischer was at the impressionable age of eighteen when the Franco-Prussian war of 1870 broke out. He mentions the war and records a few minor details concerning the way it affected his relatives. He refers several times to the war of 1914-18 as this "accursed war," but, apart from this and the loss of two of his sons, he expresses no views on a subject so remote from organic chemistry; he does indeed hope that a young relative, married in Australia, has been spared the intolerance extended towards his countrymen in the English colonies.

For Fischer politics apparently did not exist. True, he often experienced difficulty in securing financial aid for chemistry from governments, but he treats untoward occurrences of this

* "*Aus meinem Leben*," von Emil Fischer. Emil Fischer *Gesammelte Werke*, herausgegeben von M. Bergmann. Pp. 201. Berlin: Julius Springer, 1922. Price (at date of issue), 38 marks.

kind with amused resignation and uses political party names merely as a nomenclature. He was in the lap of the gods and unaccustomed to question their decrees.

In 1885 Fischer visited Corsica. Passing through Paris, he dropped his gold watch on the boulevard, but returned after a few steps and picked it up. At Marseilles he demanded a few thousand francs on a letter of credit and had to wait because the bank was short. He informs us that the "vendetta" was still practised in Corsica and that a charming account of this barbarous custom is given in an excellent novel by Prosper Mérimée, entitled "Colomba." He omits to tell us, in connexion with his earlier visit to Denmark, that Shakespeare wrote "Hamlet."

Hundreds of great names flit through the pages of these recollections. With each one is associated some petty and often sordid detail. We are told that Graebe's horse-laugh attracted the attention of all the guests in the dining-room of the Grand Hotel in Territet and that Pechmann lost most of his fortune at Monte Carlo, but the master says no word in praise or appreciation of the services rendered by these two celebrated chemists in the development of their science.

It seems to be possible in Germany for an individual of great intellectual endowments to achieve eminence in some narrowly confined branch of science and still to remain ignorant of all those weighty matters which lie outside the limited domain in which he is supreme; this is perhaps responsible for much that has happened during late years. One of my friends recently visited a German scientific man of high standing and was informed by him that England must be in a desperate state; that we have so many unemployed living at the Government charge, that the State has boarded out great numbers of them in Austria because they can be maintained there at a less cost than in England. The statement must be true, because it has appeared in all the German newspapers! A similar detachment from human concerns led Fischer to sign the notorious manifesto of the 93 in September, 1914, justifying the violation of Belgian neutrality; a few years later he expressed regret at this ill-considered action.

The unfortunate impression made by Fischer's recollections was evidently foreseen in Germany, and the earlier part of Kurt Hoesch's life, published by the German Chemical Society, consists in a journalistic paraphrase of the recollections in which the trivialities are submerged under a flood of Teutonic sentimentality. Hoesch is astonished to find so little mention of the war of 1870, and explains it somewhat naively by saying that Fischer's character was an international one, and that he was a good European or, indeed, a super-European. "Aus meinem Leben" affords no support for this ingenious proposition.

NOTES ON THE DETERMINATION OF "MIXED ACID"

W. H. PATTERSON

Various methods have been employed for the analysis of "mixed acid," i.e., mixtures of nitric and sulphuric acids, such as are used in nitration, or the spent acid left after nitration. The present notes are based on experience in comparing known methods of analysis or modifications of them.

Total acid is easily determined by titration with standard caustic soda. The alkali is added from a burette to a weighed amount of the acid to be tested until a definite pink coloration is obtained in presence of phenolphthalein (the alkali being standardised under similar conditions). In another method the acid is added to a definite volume of the alkali in presence of methyl orange until a red colour is obtained, and the excess acid is titrated with caustic soda until the colour becomes pale yellow and finally turns pink after adding phenolphthalein.

Nitrous Acid.—For the separate determination of nitrous acid the well-known permanganate method is best, and it is satisfactory for fresh acid. With spent acids, in which the nitrous-acid content is high and organic matter is always present, titration with permanganate needs careful control. The method may be employed in analysing waste acid from TNT manufacture, containing matter not readily oxidised by permanganate. The influence of organic matter is shown by its effect on the end-point when the titration is performed at different temperatures up to 100° C. The method, however, is inapplicable to waste acids from the manufacture of picric acid, as oxalic acid is invariably present. Therefore some other method of estimating nitrous acid in presence of organic matter must be used, or other methods must be adopted which distinguish between the total nitrogen and the nitrogen in nitric acid. A useful method of estimating nitrous acid alone is to add the sample to be tested to a strong solution of potassium citrate, free from carbonate, in a Lunge nitrometer. The sample is washed in with more citrate solution, and a concentrated solution of potassium ferrocyanide added; the amount of nitric oxide evolved corresponds with the nitrous-acid content of the sample. This method tends to give low results.

The analysis of mixed acid also involves the determination of the total nitrogen acids, and the nitric or the sulphuric acid. Methods which are generally applicable, and which may also be used for nitrates or nitrites in most cases, can be tabulated as follows:—

Total Nitrogen Acids.—(1) Nitrometer method. (2) Reduction to nitric oxide by ferrous chloride in acid solution. (3) Reduction to ammonia by the Arndt method, the use of Devarda alloy, electrolytic reduction, etc. *Nitric acid:* (4) Direct titration with ferrous sulphate. (5) Nitron method [after elimination of nitrous acid]. *Sulphuric acid:* (6) By evaporating off the nitrogen-containing acids and titrating the sulphuric acid directly. *Nitric acid and sulphuric acid:* (7) By double titration with barium hydroxide and sodium carbonate.

Methods (3) and (5) are not discussed in this paper; most of the other methods have been so long in use that it is difficult to quote references to the original literature.

DETERMINATION OF TOTAL NITROGEN-ACIDS

(1) *The Nitrometer Method.*—The use of a calibrated nitrometer is usually held to give correct results, but large errors may occur if the apparatus is not manipulated correctly, and especially if a large number of tests has to be made. Emphasis is laid on this point because the author has experience of two large works where serious discrepancies were found in the results of routine estimations. Two nitrometers which nearly always showed large differences were examined and the divergence was found to be due to a difference in the tap-connexion which had led to different ways of using the nitrometers. An experiment which accentuates the error can be carried out as follows:—The nitric-oxide gas is expelled through the cup after an estimation has been made, and some of the acid lying on the mercury is allowed to enter the cup, thereby becoming exposed to the air. If this acid is drawn back into the nitrometer, or the walls of the cup are washed with pure sulphuric acid, and this is again shaken with the mercury, without adding any more nitrate, a further quantity of nitric oxide will be evolved which may amount to one-half the volume originally obtained. This production of gas can be repeated indefinitely and appears to be due to oxidation of the gas in contact with air to peroxide, which dissolves in the acid on the walls of the cup. A similar phenomenon may occur to some extent in the bore of the tap. Nitrometers should, therefore, always be constructed with a side-tube and cup connected by a two-way stopcock with two parallel diagonal bores (Greiner-Friedrichs cock). The gas can then always be expelled through the side tube, never through the cup, and each bore of the tap is used for one purpose only. About 5 c.c. of 90 per cent. sulphuric acid should be used with the sample in the nitrometer. Acid of greater strength must, according to Lunge, be avoided, and weaker acid gives a low result. A sample treated with sulphuric acid diluted to 50 per cent. gave as result 26.1 per cent. nitric acid, but when treated with the same amount of acid of 90 per cent. strength, 26.3 per cent. Also, with the more dilute acid, the action is slow at first and the mercury blackens and loses mobility.

(2) *Reduction to Nitric Oxide.*—The method of reducing to nitric oxide by ferrous chloride in acid solution, known as the Schlösing-Grandeau or Tiemann-Schulze method, has been modified by De Koninck and others (*cf.* Lunge-Berl., "Chemisch-technische Untersuchungsmethoden," 7te Auf. I., p. 783 *et seq.*). To compare this with other methods the following modification was used:—The ferrous chloride solution and the hydrochloric acid were boiled in a flask until free from air, and the flask was connected through a mercury seal with the gas-measuring tube, the drop of the delivery tube to the mercury being greater than the barometric height. The sample of acid to be tested was added to the flask by a tap-funnel. The volume of gas evolved may either be reduced to N.T.P. and calculated as nitric acid, or it may be compared with a standard volume of nitric oxide obtained from a known amount of pure nitrate or nitric acid. The two methods give slightly different results. Using spent acid and the nitrometer method, the results agreed within 0.05 per cent.; with fresh acid a result within 0.12 per cent. could be obtained by

careful measurement and correction of volume, but when an old standard volume is used the result may be too high by 0.2 per cent. or more. The liability to error is greatest in making a first estimation with a fresh charge of ferrous salt. It has been proposed to extend the method to the determination of nitrous acid (*cf.*, Meisenheimer and Heim, Ber., 38, 1905, p. 3834) by reduction to nitric oxide with potassium iodide; Raschig, Ber., 38, 1905, p. 3911), separate determination by titrating the free iodine in an atmosphere of carbon dioxide; (Strecker, Ber., 51, 1918, p. 997) estimating the nitrite in neutral solution as nitrogen, after decomposition with a very large excess of ammonium chloride. No attempt has been made to compare these methods with others mentioned.

DETERMINATION OF NITRIC ACID

(4) *Direct Titration with Ferrous Sulphate.*—It has often been doubted whether even approximate results can be obtained by this method, which dates at least from 1847. Bowman and Scott (Chemical News, 114, 1916, p. 39) showed that if properly carried out, it could safely be used for estimating nitric acid alone in presence of other acids (with some exceptions) or of nitrites. Since then a modification of the method has been shown to be capable of giving results agreeing within 0.1 per cent, with those obtained for nitric acid determined by the nitrometer, or for pure nitric acid estimated by direct titration.

The ferrous sulphate solution, made by dissolving the pure crystals in 30 per cent. sulphuric acid, is added directly from a burette, and the end-point is marked by the formation of the brown colour due to interaction between ferrous sulphate and nitric oxide. The conditions necessary to obtain results accurate within 0.1 per cent. are as follows:—(a) An excess of sulphuric acid must be used; hence the sample to be titrated, about 0.5 g., is mixed with about 100 c.c. of concentrated sulphuric acid. (b) The flask is kept at a temperature of under 30° C. in water and agitated during titration. (c) The factor of the ferrous sulphate solution is determined just before use by standardisation against a known amount of pure nitrate or nitric acid. This procedure eliminates most of the error due to change in volume of the ferrous sulphate solution (which has a large temperature-coefficient), error by different observers in judging the end-point, and also the error due to the small amount of solution necessary to give the end-point colour, *i.e.*, to effect reduction to nitric oxide. A sharper end-point might be obtained if most of the colour due to formation of ferric salts were eliminated by titrating with stannous sulphate, containing some ferrous sulphate, in a neutral atmosphere.

DETERMINATION OF SULPHURIC ACID

(6) *By Titration after Evaporation of the Nitrogen Acids.*—This method, which is used on the ground of convenience, was carried out for purposes of comparison as follows:—About 1 g. of the sample was run into a porcelain evaporating-basin (diam. 7 cm.). After evaporating for at least 30 minutes on a water-bath, 1 c.c. of water was added, the liquid stirred with a small glass rod kept in the basin, and then heated for 15 minutes more. The sulphuric acid was then titrated, using methyl orange as indicator. Experiments showed that this

method could give almost correct results, but it was not always reliable, the sulphuric acid content being in some cases more than 0.5 per cent. too high.

DETERMINATION OF NITRIC AND SULPHURIC ACIDS

(7) *By Double Titration.*—This titration described by Langbein (*Z. angew. Chem.*, 13, 1920, p. 1227) may be slightly modified as follows:—Total acid is determined by titrating the hot or boiling solution with barium hydroxide, using phenolphthalein as indicator. A known amount of standard sodium carbonate is then added in excess, the precipitated barium sulphate and carbonate are filtered off, and the excess of sodium carbonate titrated with standard hydrochloric acid, using methyl orange to show the final end-point. This method gives low results for nitric acid, but it is speedy, and there is no error due to the precipitate passing through the filter paper. It is accurate enough for corrections in bomb calorimetry, for which purpose it was used by Langbein, or even for the determination of the sulphur content of a fuel, since under the conditions of combustion or explosion in compressed oxygen, sulphur is oxidised completely to sulphuric acid, and is found, together with nitric acid, in the liquid in the bomb.

ELECTROCHEMICAL DEVELOPMENTS IN ITALY

Industrial conditions in Italy are very different from those to which we are accustomed in Great Britain. The main problem which confronts the Italian technologist is the high price of fuel, due to the fact that home supplies are negligible; on the other hand he has abundant water power. These circumstances tend to promote chemical development along electrochemical lines, and as one consequence much attention has been devoted since the war to the production of electrolytic alkali. The development of this industry was hampered at first by the usual difficulty of finding an outlet for the chlorine, which is produced simultaneously, but this problem appears to have been solved successfully and on somewhat original lines, with the result that an interesting group of industries has been established. Some of these developments are described briefly in the following notes.

The imports of caustic soda into Italy are considerable, but have dropped from 19,844 metric tons in 1916 to 13,921 t. in 1921. The total internal consumption is about 22,000 t. per annum, of which only 5,943 t. was produced in the country in 1913. To-day the potential internal production, if all the works were working at full capacity, would approximately cover the demand.

At the Pomilio Electrochemical Works (*L'Elettrochimica Pomilio*) near Naples, caustic soda is produced in Pomilio-Giordani electrolytic cells in which the yield per unit of current is about 93–95 per cent. of the theoretical. There are three batteries of 100 cells each, and each cell takes 3000 ampères. The output per 24 hours is 10 tons of 100 per cent. NaOH, obtained as a solution of 120 to 140 g. per litre, which is worked up in the evaporators and fusion pots to soda lye of the commercial strengths 38–40° Bé. and 48–50° Bé. and to fused caustic of 72–74° English degrees. Under Italian conditions it is, of course, necessary

to reduce to a minimum the fuel charges for evaporation; by using electrically-driven heat-pump evaporators and so utilising the thermal energy of the fuel to the utmost the company has succeeded in reducing the coal required to evaporate each cubic metre of water in the production of 48 Bé. caustic lye to 16 kg., as compared with 48 kg. with multiple-effect vacuum pans, 210 kg. by heating with indirect steam, and 260 kg. by direct firing. Naturally this extreme economy of coal is only effected by the auxiliary use of electric current to the amount of approximately 230 kw. per cb.m. The caustic fusion pots are also of special type, coupled in parallel or in series, with tangential heating and recovery of the heat of the chimney gases which are said to reduce the fuel charges to 75 per cent. of those incurred by using pots of less recent type. The chlorine is used for the manufacture of bleaching powder, synthetic hydrochloric acid (for which purpose the hydrogen from the batteries is also utilised), sodium hypochlorite and zinc chloride; in future it is to be used for the production of potassium and aluminium chlorides, alumina and silica from the leucite of the volcanic rocks in the neighbourhood. The chlorine is also utilised in producing pure cellulose from hemp fibre and other raw materials. Three thousand tons of bleaching powder is produced yearly in leaden chambers; the hydrochloric acid plant has a capacity of 2000 t. per annum, and 160 t. per month has been actually obtained. The annual production of sodium hypochlorite is 2000 t., which is absorbed by local textile and other industries; and the output of 50 tons per month of zinc chloride is supplied to the State railways for the impregnation of sleepers.

The Pomilio company is now producing pure cellulose by the Cataldi process in a recently erected works, the output being 7 to 8 tons per day. In this manner an outlet has been found for the surplus chlorine, and the development is expected to have a very good future. The main raw material is hemp fibre, which is the dry residue from the beaten and macerated hemp plant. The annual production of this material in the Province of Naples is 25,000 tons. Hitherto this product has been used only on a small scale for fuel. The method of treatment is essentially Cross and Bevan's analytical method of estimating cellulose, adapted for industrial purposes, and consists in treating the fibre successively with dilute caustic alkali solution, moist chlorine, and again with dilute caustic alkali. The main precaution necessary on the manufacturing scale is careful regulation of the access of chlorine, as otherwise excessive heating takes place and the fibre is destroyed, or even charred. Large quantities of hydrochloric acid are evolved. Other raw materials are used instead of hemp, namely poplar wood, esparto and straw. The quantities required for the production of 100 kg. of poplar cellulose are: moist chlorine gas, about 28 kg.; coal about 15 kg.; bleaching powder (for subsequent bleaching) about 6 kg.; and sodium hydroxide, in dilute solution, 5 kg. To produce 10 tons of cellulose per day by this method only 50 workpeople are required and about 80 kw. of electric power. The amount of water required is not greater than in other processes. A plant of the above-mentioned output requires about 1500 sq. metres of covered floor-space. The above figures represent a maximum of

chlorine and minimum of caustic soda, the object being to balance the ultimate demand for these two materials, but the quantity of chlorine can be considerably reduced if the consumption of alkali is increased. The alkali is used in a very dilute condition.

A further possible outlet for the surplus chlorine on a very considerable scale has been found in the production of synthetic hydrochloric acid and its use for decomposing the volcanic rocks which abound in Italy, and which represent the richest and largest source of potassium compounds known. It is calculated that the leucitic rocks of the active and extinct Italian volcanoes, of which six are included in the computation, contain in round figures nearly 8800 million tons of potassium oxide, or rather more than is present in the Stassfurt deposits, and about 25 times as much as in Alsace. It appears to be comparatively easy to separate from these rocks, by ordinary magnetic and other mineral separation methods, leucite, $K_2O \cdot Al_2O_3 \cdot 4SiO_2$, of a purity of about 90 per cent., and containing therefore about 19.5 per cent. of potassium oxide. It has been found that finely-divided leucite is readily attacked in the cold by hydrochloric acid, forming a solution of potassium and aluminium chlorides on the one hand and a residue of silica, which can be washed, sieved, and sold at a low figure, on the other. The solution of the mixed chlorides also contains small amounts of iron salts and silica in solution. Processes have been patented by Giordani, Pomilio, Blanc and Jourdan, and are being worked out on a semi-industrial scale, for the treatment of the acid solution of the mixed chlorides by several methods. By the first of these, a large part of the potassium chloride is recovered by cooling; the solution is then neutralised and the remaining silica thus precipitated is filtered off. The solution is freed from iron electrolytically, and electrolysis is also employed to precipitate the alumina, the production of aluminates being avoided by the use of a neutral catholyte. The chlorine and hydrogen produced during electrolysis are recovered and re-utilised. Alternatively, the solution of the mixed chlorides is successively subjected to such temperatures and pressures as to dissociate or otherwise separate each ingredient in turn. The solution of the chlorides is heated to 300°–600° C., and the chlorides of iron and aluminium, and even those of calcium and magnesium, are successively decomposed with recovery of hydrochloric acid. The aluminium chloride can also be separated by utilising its diminished solubility in presence of excess of hydrochloric acid in the cold.

By the methods indicated, products of the following degrees of purity have been obtained:—Potassium chloride crystals, KCl 99.7%, water 0.25%: free from silica, iron oxide or alumina; aluminium chloride crystals, Al_2O_3 17.5–19.7%, K_2O 0.91%, Fe_2O_3 trace: free from silica and lime; alumina, Al_2O_3 99.8%; SiO_2 0.19%: free from iron oxide and lime. It is important to note, bearing Italian conditions in mind, that by certain of these processes the leucitic rocks can be treated successfully without the use of any fuel whatsoever. As instancing the enormous amount of raw material available for this outlet for electrolytic hydrochloric acid, it may be noted that during the last eruption of Vesuvius in 1906 about 200 million tons of volcanic ash was ejected.

NEWS FROM THE SECTIONS

AMERICA

At a meeting of the American Section, held on October 20 in the Rumford Hall of the Chemists' Club, New York, the Grasselli Medal was presented by the chairman, Dr. Harlan S. Miner, to Mr. W. H. Fulweiler, of Philadelphia. In making the presentation Mr. Miner spoke as follows:—

The American Section of the Society of Chemical Industry is highly favoured in being able to give some tangible recognition to the meritorious papers presented at its meetings. The Grasselli Medal and the conditions controlling its award are distinctly American in character. The fact that it is awarded for the paper which, in the opinion of the Medal Committee, offers the most useful suggestions in applied chemistry, makes it peculiarly appropriate to an industrial society. This is only one of many ways in which the donors are advancing the profession of chemistry in the United States. The Committee of Awards has this year unanimously chosen as the recipient of this honour Walter Herbert Fulweiler, of Philadelphia, in recognition of the paper which he presented at the March meeting of the Section, entitled "Chemical Problems in the Gas Industry."

Born in Philadelphia on January 3, 1880, the medallist graduated from the University of Pennsylvania in 1901, with the degree of B.S. in chemistry. Having decided to devote his attention to the gas industry, he first accepted a position as chemist in one of the stations of the Philadelphia Gas Works. We next find him as cadet engineer and later as superintendent of manufacture of the Kansas City Gas Co. Returning to Philadelphia in 1907, he entered the Department of Tests of the United Gas Improvement Co., becoming chief chemist in 1913 and chemical engineer to the company in 1920.

As might be expected, Mr. Fulweiler's work in connexion with the gas industry has been of a very practical nature, and has had a decided economic application, although he has by no means ignored the purely scientific side of his subject. With an intimate personal knowledge of the industry, both from an American and a European point of view, he constructed one of the first waste-heat boilers on a water-gas set. Then he assisted in the design and erection of the first American type of vertical retort at Manchester, N.H.

The utilisation of some of the ill-smelling by-products of the gas industry is worthy of note in this connexion. Our medallist developed and introduced the successful road-binder known as "Ugite"; also the first cold patching-material made from tar which is now extensively used in road maintenance. He invented the "cut-back" method of manufacturing tar products used in the surface treatment of roads, and also devised an apparatus for determining the binding value of pure bitumens in road construction.

The refining of benzol products recovered from illuminating gas was thoroughly investigated, particularly with reference to the production of toluene. Like other loyal chemists connected with our "key" industries, he collaborated with the Ordnance Department during the war, studying particularly the manufacture of toluene. In addition to reporting on several methods for producing this material, so urgently needed at that

time, he developed and perfected a process for its manufacture by a heat treatment of Californian distillates, and assisted in the construction and operation of two plants to work this process, one at Los Angeles and the other at San Francisco, the former having a production of 3 million galls. a year at the time of the armistice.

Another subject upon which Mr. Fulweiler worked during the war period was the development of a motor fuel for our air service, finally producing one, as a by-product from the operation of the toluene process, which, under tests at the flying fields, enabled the training plane to climb about 5 per cent. faster and with an economy in fuel consumption of about 8 per cent. This fuel consisted essentially of 60 per cent. unsaturated hydrocarbons, 30 per cent. benzol, and 10 per cent. paraffin hydrocarbons. Refined by a special process, it was found possible to eliminate gumming and corrosion.

In more recent years our medallist has made a very extensive study of the petroleum oils used in the gas industry, with special attention to the development of methods for their identification. These researches, which are still in progress, involve the preparation of a large number of hydrocarbons from different series and the determination of their physical constants, among which are several unusual ones, such as magnetic rotation, electrostatic double refraction, and absorption spectra, particularly in the ultra-violet.

An examination of the many published articles from Mr. Fulweiler's pen indicates still further the great diversity of his researches and developments. A paper on "Physical Theory of Coal Carbonisation," as early as 1908, was awarded the Beale Medal by the American Gas Institute. This was followed by "Theory of Flame and Mantle Illuminosity," "Physical Characteristics of Ferric Oxide," "Purification of Water for Gas-making Purposes," "A Source of Light, giving a Continuous Spectrum in the Ultra-Violet," "The Development of Modern Road Surfaces," "Destructive Action of Motor Traffic on Road Surfaces," and "Refractory Problems in the Gas Industry."

The subjects of wood-preserving and of refractories, both vital to the economic success of a gas plant, have received very careful study, as have also the many intricate problems involved in gas purification. In this field researches have been conducted to determine the nature of the sulphur compounds in illuminating gas, and also the chemical reactions involved in the purification by iron oxide and its subsequent revivification.

These and other papers, in addition to the one for which this medal is awarded, demonstrate conclusively that the industry, which had its inception over a century and a quarter ago in a relatively crude way, now maintains its important position as a result of systematic scientific research and control. Notwithstanding the volumes that have already been written describing the work of the scientists in this and earlier generations, our medallist has found new fields to investigate and has achieved results that have materially advanced the industry in which he has chosen to labour.

We are glad to find a man who will freely impart the information obtained through his researches and experience, and is willing to publish papers which, as our donors suggest, "offer useful suggestions" to his colleagues.

On behalf of the American Section of the Society of Chemical Industry, I am honoured in presenting to you, Mr. Fulweiler, this beautiful medal, not so much as an incentive to spur you on to other and increasing activities, for you do not seem to require such a stimulus, but as a token of appreciation from your many friends in the chemical profession. May you ever see in it an expression of our good-will and may it bring you much happiness throughout a long and useful life.

Following the presentation, Mr. F. E. Hartman read a paper on "Ozone Generation, and the Industrial Application of Ozone," which contained, *inter alia*, the results of some original work on the action of ozone in accelerating the drying of paints and varnishes, and in bleaching linseed oil. A further paper, by Mr. E. Felkel, on "The Effect of Ozone on Organic Compounds," discussed the general properties of ozonides and the action of ozone on each of the more important groups of organic compounds.

LONDON

The first meeting of the new session was held on November 6 in the Engineers' Club, London. The chairman, Mr. E. V. Evans, presided, and announced that a joint meeting had been arranged with the Biochemical Society on January 8, 1923, to discuss the subject of micro-organisms and their application to industry.

Further, Mr. Evans stated that the Committee had been fortunate in obtaining the consent of Dr. E. F. Armstrong, the President of the Society, to address them on this occasion. He did not propose to introduce Dr. Armstrong or to talk of his achievements: he was known to all of them, and his merits were everywhere recognised. The Council of the Society was really to be congratulated on having obtained Dr. Armstrong's consent to be President of the Society at the present moment, because he (Mr. Evans) could assure them that the responsibilities being undertaken at the present time really necessitated a man of Dr. Armstrong's calibre. He (Mr. Evans) was one of those who were perfectly confident of success in the new ventures that they were to undertake with Dr. Armstrong as their leader.

Mr. Evans then called upon Dr. Armstrong to give his address on "Some Problems in Chemical Industry."

Dr. E. F. Armstrong, in the course of his address, said:—Some few weeks ago your secretary did me the honour of insisting that I should come here to-night, and I understood I was to address you in Burlington House. I, therefore, prepared an elaborate scientific address suitable for the four walls of that august establishment, but when I heard suddenly, a day or two ago, that the meeting was to be here, the only thing to do was to burn that address and to make remarks more appropriate to the occasion. I am not at all certain whether one ought not to say that the move is perhaps a wise one.

The subject which concerns all members of the Society of Chemical Industry, members of the chemical fraternity, more than anything else at the moment, is the means of our livelihood. The Chemical Society has entrusted to it the safeguarding and advancement of chemical science. We in this Society have rather different functions to fulfil,

functions which I would like to suggest to you call for other qualities than those of being, I will not say a mere chemist, but merely a chemist. "The Society of Chemical Industry" was the title given to us by our founders, 41 years ago, but to-day I think we ought to call ourselves the Society for the Promotion of Chemistry in Industry. It is very difficult to define chemical industry; those who formed the Association of British Chemical Manufacturers had very much wider ideas as to what was a chemical manufacturer than has proved to be the case. Those engaged in many branches of manufacture, who, it was thought, were chemical manufacturers, have chosen to regard themselves, not as chemical manufacturers, but as manufacturers of a particular article, and, in consequence, have not allied themselves to the chemical industry. I fear that the tendency at the present time is to restrict more and more the term "chemical industry" to the very definitely chemical industries. If we take as our title "the promotion of chemistry in industry," then nearly all industries become chemical industries, because chemistry is at the foundation of all.

THE STATUS OF THE CHEMIST

Our Society, more than any other, represents the chemists of the country. Our efforts are supplemented to-day by the Institute of Chemistry, a body which is worthy of all praise. There was, in the past, a tendency to confine the Fellowship of the Institute to the restricted, although eminent, classes of chemists known as consultants and analysts, but that tendency has gone, and to-day the Institute is enrolling within its ranks, either as Fellows or Associates, everybody who is worthy of being called a chemist. In addition to the Institute we have the British Association of Chemists, of which I have a very high opinion. I regard it as the left wing of the party, and a party without a left wing is almost no party at all; we must have stimulus from within. I think both the Institute and the British Association of Chemists, and certainly ourselves—the non-political mother society—have all the same mission. We want to see the status of the chemist placed on a high plane, and I shall regard it as my duty, whenever you give me the opportunity to speak publicly, to state the fact as clearly as I can for the benefit of the outside world, that we chemists do claim to be a body of very highly trained, highly skilled professional men. Our training has been that of method, scientific method. We are gifted with certain knowledge which enables us, so to speak, to take things to pieces, and with an ability to predict events, because of our knowledge of chemical properties. Still more, some of us are in the position of exercising constructive thought, and I want to put very definitely that the nation has in its chemists a body of men in whose hands a great deal of the future of civilisation rests. If we are to take up this honourable position that we claim for ourselves, we must, like the doctors and the lawyers, have a very high standard of professional conduct. Remember, the British public is our judge. We must not despise the British public, because, although slow, it is sure, and its judgment is, in the long run, correct. And here I want to enter a strong protest against the action of certain chemists in misleading the public. I do not think any chemist has any right to set his name, much less his qualifications, to documents which are published

in company prospectuses and elsewhere with intent to mislead. Of course, I am making these remarks without reference to any individual. I wish to emphasise the necessity of no chemist setting his name to documents that may mislead the public. The public is essentially gullible, but it has a long memory, and if Mr. X—, F.I.C., F.C.S., deceives the public once, the public will in future regard all F.I.C's. and F.C.S's. as of the same stamp. It is also time publicly to enter a protest, not against the use of the term "chemist"—because that has long since passed beyond our control—but against the qualified chemist in any way doing anything to perpetuate the existence of the unqualified chemist. During the war the mistaken policy of the Government in sending chemists into the trenches caused a shortage at home, and all sorts of unqualified men had to be brought into the factories. They did fine work, and it is to their credit, but during the recent trade slump the employer has parted with these men wholesale, unfortunately, thinking they were representative chemists, and I fear that it will take a considerable time to live down some of the mistakes made at that time.

THE RUSTING OF IRON

Another matter for our consideration is whether chemists, as a class, contribute as much as they might to the general good of the community. Sir Robert Hadfield has calculated that there is an annual loss to the world of 40 million tons of iron and steel as the result of atmospheric corrosion, and that the monetary value of this loss is about £500,000,000 per annum. Sir Robert Hadfield has put some of these facts together in a recent number of the Royal Society's *Transactions*, and he calls attention to the fact that this is the first paper dealing with the subject that has appeared in those *Transactions* for 100 years. Now, think of it; a chemical factor which causes the loss of £500,000,000 per annum dealt with once in a hundred years by our leading scientific society! I am, of course, aware that the Institution of Civil Engineers and similar societies have considered this subject; and that there are many firms who specialise in anti-corrosive preparations; and one is very glad to note that these firms have recently come together and formed an association; but is not this state of things rather a reflection on the chemist? At a certain college in Kensington the students were not taught chemistry in the conventional way, but they had put to them the problem of what happens when iron rusts; many of these students have since become engineers. Teachers of chemistry have not favoured the Kensington method, and if any chemist mentions iron rust in public it probably causes more ridicule than attention.

SMOKE ABATEMENT

Our attention has recently been directed to the Smoke Abatement Bill, which, I believe, was fathered by Lord Newton and introduced into the House of Lords. That Bill is, presumably, based on the report of a commission, reports of committees, and investigations undertaken by a great number of active men who have long made a hobby of this particular question. The researches of these people, however, prove that four-fifths of the smoke nuisance in our industrial centres and great towns is due to the domestic fire; but the Bill does not mention the domestic fire; all it does is to select the

manufacturer and threaten him with increased penalties. Of course, there are manufacturers today, and always will be, who let a great deal more smoke into the air than they would like to, but I am rather doubtful if it is the business of the manufacturer to prevent smoke. If a person sets out to produce a particular substance, he becomes an expert in its manufacture, often to the exclusion of everything else; he spends his capital, and puts his energy and brains into the business. There are certain standard pieces of plant which he has to buy from those who specialise in that plant, and he expects to find it of the highest and most up-to-date quality. One would not, of course, expect the soap-maker to experiment with boilers. Why should he? Nor the biscuit-maker to experiment in smokeless fuels or some new type of powdered fuel. That kind of work ought to be done by the chemical fraternity generally, acting with the engineers and the particular people who specialise in these types of plant. I believe that one of the greatest advances that we, as a Society, have made during the past five years will be found to be our Chemical Engineering Group, because that Group is very earnestly and sincerely trying to bring chemists and engineers together to solve these common problems.

WATER-SOFTENING

There are many satisfactory methods of softening water, and one of the most interesting and novel is that based on the extraordinary power of zeolites, both natural and artificial, to exchange bases. When a hard water containing lime and calcium and magnesium salts is passed over a zeolite, the sodium of the zeolite is exchanged for calcium and magnesium; the artificial zeolite—Permutit—is used extensively for this purpose. A material of this kind is really a very remarkable one, of which, as chemists, it is perhaps well worth our while trying to form a mental picture. In this problem structure—surface activity—plays a very important part. The preparation of Permutit, formerly made as the result of a fusion process, and later by precipitation, involves processes which have an adverse effect on structure. We know little of how natural zeolites (two of which are quarried in the United States and sold under the fancy names of "Boronite" and "Refinito") are formed, but, judging by their activity, it appears certain that their structure must have been adversely affected—from our point of view—in the process of formation. It struck us that it ought to be possible to prepare a much more satisfactory material by milder means. Zeolites are complex alumina silicates of unknown constitution, and we, therefore, took solutions of sodium silicate and sodium aluminate and mixed them in concentrations and under conditions of temperature which were found to be the most suitable. A few minutes after mixing, the whole mass sets to a jelly. When exposed, the jelly gradually dries to a solid material, a dried "gel," which in the apparently dry state contains about 50 per cent. of water. This material is very active in exchanging its sodium for calcium and magnesium, in fact, we guarantee it to exchange 5 per cent. of its dried weight, and we have obtained an exchange of 7—8 per cent. So far as our experience goes, the exchange in the natural materials is only 0.25 per cent., and for Permutit 1.6 per cent.; so that we have produced a substance which is at least four times as active as similar materials, either produced naturally or

artificially by rougher methods. This is an example of the inter-relationship of chemical action and preservation of surface. When the material, prepared as indicated above, is placed in a suitable cylinder and water run through, the substance that is left after the soluble by-products of the initial reaction have been washed away is of constant activity and can extract definite amounts of calcium and magnesium from water passing over it at a very high rate of flow. The process can be reversed almost instantaneously by passing through the filter a relatively concentrated solution of common salt, the calcium and magnesium being washed away and replaced by sodium. The material has been named "Doucil," and is believed to be represented by the formula $\text{Al}_2\text{O}_3 \cdot \text{Na}_2\text{O} \cdot 0.5\text{SiO}_2$.

TECHNICAL JARGON AND PROFESSIONAL UNITY

The necessity for clear thinking and clear expression is as great as ever it was. To-day it is practically impossible for anyone to have a really good working knowledge of theoretical chemistry because so much of the literature is replete with jargon and complex technical terms. Plain language is also essential in dealing with workmen; and if we do not use it on public occasions we shall continue to assist the undesirable process of splitting up into small separate organisations. In that connexion I am of opinion that more harm is done to the cause of chemistry by the formation of new societies than good is done to any particular branch. Surely the scope of this Society, or, if you prefer it, that of the Chemical Society, is sufficiently large to satisfy the needs of all. Without a closer union than exists at present, the voice of the profession and industry will never be heard to its full effect.

DISCUSSION

The chairman said that Dr. Armstrong had dealt with a number of subjects which should form an admirable ground for discussion. He himself had taken some interest in the question of smoke abatement, and was of the opinion that Lord Newton's Bill was a little premature. As a chemist retained by a gas company, he naturally knew of a very valuable smokeless fuel. At the same time he knew that distillers of coal were beginning to realise that there would always exist a demand for solid fuel in every house, at least during the present century, and although he was very appreciative of what coal gas could do, yet he realised that solid fuels were also required. There was no reason why, in the future, there should not be—and he believed there would be—an admirable solid fuel which would not be as expensive as coal. At the same time he felt that, although smoke abatement was required, it was useless for a committee to make recommendations which might very largely influence the progress of industry when four-fifths of the trouble arose from the domestic grate.

Mr. W. J. U. Woolcock said that Dr. Armstrong had done very good service to chemistry and chemical industry in making the chemist feel that he could not be a chemist alone; that if he was going to do the real kind of thing which he was capable of doing in the world, he had not only to be a first-class chemist in his own subject, but he had also to take a rather wider view of his responsibilities with regard to the public. It was essential that every member of the Society should be a little point of

propaganda in order that the general community might realise what the chemists really meant by calling themselves chemists. Dr. Armstrong did not say, but he might have done, that the Smoke Abatement Bill was dead, just as every other Bill was. It was, he supposed, one of the most stupid Bills having some bearing on chemical industry which had ever been brought to light.

Mr. Walter F. Reid, in referring to the Smoke Abatement Bill, said that chemists had no reason whatever to fear the new Bill, which would be introduced into Parliament as soon as it was possible to do so. The old one had defects that were due to the fact that the officials who drafted the Bill would not put into it what they had been asked to. When an influential deputation went to the authorities who were entrusted with this matter, the best spokesman and the most convincing advocate in favour of the Bill was a distinguished chemical manufacturer. If they asked too much, they would get nothing at all. It was quite impracticable to prohibit the use of coal in the grates already in existence, but it was well known that the closed stoves used on the Continent utilised three or four times the heat that our open fires did and that all the necessary household operations could be performed with them; and the atmosphere was not polluted. When the new Bill was introduced he believed they would find that some of the chief difficulties would have been surmounted. The great difficulty hitherto had been to prove the emission of what was erroneously called "black" smoke. As soon as the material in the smoke became black it was soot, but legally it was smoke, and the case had been stretched and many convictions obtained in respect of a large volume of a dark material. That would be altered, and there would be some tests which might possibly be useful and fair to the public and fair to the manufacturer. Reference had been made to the want of union among chemists and the starting of new societies. They had tried the Group system so as to include other industries in their Society, as in the case of the Chemical Engineering Group, but when the effort was made to have another one in connexion with the important paint and varnish industries, the Council of the Society did not see its way to offer the facilities that had been given to the Engineering Group. The consequence was that an Institute of Paint and Varnish Technologists had been successfully formed, and that body would in future deal with the enormous industry connected with paints, varnishes and oils, to the exclusion of the Society of Chemical Industry. In that connexion, he felt that one or two words of Dr. Armstrong rather hinted that the paint and varnish trade might object to anything that was done to prevent corrosion of metal, but that was not so. One of the chief objects of the Institute was the promotion of means for preventing corrosion and oxidation of metals. The figures given by Sir Robert Hadfield were most convincing, and it really was a disgrace to chemists that they had never been able to find anything that would cover iron or steel in a simple way and prevent the enormous waste of money that was going on. Finally, he would like to make a suggestion with regard to new words in chemistry. If the Publication Committees of the chemical societies were to keep a list of these new words which appeared and were put forward as being necessary, and if they compared that list from time to time, an

authoritative statement might be made as to the adoption of each of them.

Dr. Ormandy congratulated the Committee of the London Section on the move it had made in leaving Burlington House. The President's address was an excellent augury for the future of the Society. It pointed to the probability of that closer co-operation between the Council and the members which was so eminently desirable, and which, in the opinion of many, had hitherto been lacking. He was also gratified to hear the President and the chairman speak so highly of the services rendered by the Chemical Engineering Group. The President was hardly fair to the chemists in his strictures regarding their work in relation to the rusting of iron and steel. Much had been done; there was a vast literature; and probably through the work of the metallurgical chemist in the production of non-rusting iron and steel the problem would find solution. Having been connected with the "Permutit" process, he was interested in the President's remarks regarding the more active zeolites, but he was under the impression that the Permutit Company was making the zeolites along the lines outlined that evening. For the production of water practically free from dissolved substances, the lime-soda process, combined with an electrical process, was making great headway on the Continent.

Dr. Stephen Miall said he had not been mixed up with chemistry for many years, but he had noticed a very great difference in the attitude of the public towards lawyers and the attitude of the public towards chemists, and he believed that this was due to the fact, as Dr. Armstrong, Mr. Reid, and others had said, that chemists did not make themselves intelligible to the public, and also to the fact that chemists looked at things too much from their own individual point of view. The result was the tendency to split up into small societies which had also been referred to. Whether it was right or wise that that state of affairs should exist was another matter, but he noticed in the chemical profession a large number of journals each dealing with one particular branch of chemical industry or of pure chemistry, and appealing to a limited audience. That was not so in the law at all. He supposed there were far more lawyers than chemists—and it might be monstrous that there should be—but the law did not have a number of journals each with a circulation of a few hundreds or a few thousands; lawyers had combined together to a much greater extent than chemists. They ought to be grateful to Dr. Armstrong for advising chemists to have a better conceit of themselves and show the public that they deserved not only the prominence that they had now, but the increasing prominence which they were going to have in all matters of civilisation in the future.

Mr. W. Cullen said he had had a great deal to do with lawyers recently, and his experience had not given him a very great admiration of the manner in which they made themselves intelligible to the ordinary public. With the general tone of the President's address and Dr. Miall's speech he was in entire agreement. He himself belonged to the old type of chemist, and he sometimes felt hopelessly discouraged when he tried to keep himself up to date with the terrible technical jargon of to-day. He hoped this aspect of Dr. Armstrong's address would be taken up very seriously.

Dr. E. Fyleman said he was amused at the extraordinary awe which the bulk of the speakers had of the atmosphere of Burlington House. It seemed to him that Burlington House was similar to most other places, but it certainly lacked the facilities for carrying out experiments. It might be right for the lawyers to have one journal and one society, but one was liable to overlook the comprehensiveness of chemistry and chemical industry. Was it seriously suggested that there should be one comprehensive journal to include such topics as the more abstruse sides of biochemistry, metallurgy, the paint and varnish industry, and so on? It would be quite impossible: it would be necessary to have a bi-weekly journal of the size of the present fortnightly one in order to cope seriously with all the many phases of thought and activity with which chemists were concerned. They might widen the scope of their abstracts, but he thought they would agree with him that the man who contented himself with reading abstracts would not get very far. They were lifeless things and did not help one as much as one would like.

After some remarks by Messrs. Barker and Booth Harris, the chairman proposed a vote of thanks to the President and said that the experience gained that evening would induce the Committee of the London Section always to invite the new President to address the opening meeting of the session. He had been present at a number of such meetings and he had not left one happier or more contented regarding the future welfare of the Society than he would do that evening. Dr. Armstrong, acknowledging the vote of thanks, said that we wanted a close time for chemists just as much as we wanted a close time for the country. We should stop awhile and consolidate the ground; that was the doctrine he had been preaching to them.

GLASGOW

The second meeting of the session was held on November 17 in the Institute of Engineers and Shipbuilders. The chairman, Mr. W. E. Moodie, announced that arrangements had been made for members to visit the works of Messrs. J. G. Jackson, Ltd., of Pollokshaws, on December 9, and inspect various types of "filling" machines. Mr. A. B. Steven then read a paper on "Artificial Silk," in which he summarised the history of this important textile. The first suggestion for producing artificial silk was made by Réaumur in 1731, viz., by drawing out varnish into a fine thread; but no progress was made until 1855, when Audemars nitrated cellulose, dissolved it in a mixture of alcohol and ether and drew out fine threads from the solution. The first workable nitrocellulose process was patented by Chardonnnet in 1884; the threads, however, were very inflammable and subsequently the material had to be de-nitrated. In 1897 Pauly patented the use of Schweitzer's reagent, and "viscose" silk was introduced by Cross and Bevan in 1891. The most recent development is that of "acetyl" silk, which is made by treating cellulose with acetic anhydride or acetyl chloride in presence of a catalyst. The product, triacetylcellulose, is practically waterproof. Mr. Steven referred to the many attempts that have been made to produce artificial silk with a non-cellulose basis, and explained several tests to distinguish natural from artificial silks.

SOUTH WALES

A meeting of this Section was held in Cardiff on November 3, at which Prof. W. J. Jones presided and Mr. J. H. Duncan gave a paper on "The Physical Testing of Coal." The paper set out the importance of the scientific control of coal to be used for commercial purposes and emphasised the advantages of simple physical tests over the more tedious academic method of ultimate analysis. South Wales coals are so variable in composition and properties that it is most desirable that they should be blended and the mixture sold on a guarantee, which should state not only the analytical constants, such as ash, calorific power, and volatile matter, but should prescribe how such tests are to be performed. Mr. Duncan gave an account of the manner in which a cube of coal "cauliflowers" when placed in front of a muffle. The character of the "cauliflowering," taken in conjunction with the careful examination of the button of coke left after the determination of the volatile matter, affords to the practised eye most valuable indication of the way such coal will behave in a furnace. By such tests more information is afforded as to the rate of combustion and opening-out of a coal than by most elaborate ultimate analysis and chemical tests which are not desirable for commercial purposes.

In the discussion, Dr. S. Roy Illingworth specially pleaded for the more exact methods of chemical examination of coal, advocating that such tests not only afforded much more reliable information of the value and properties of a coal, but also furthered exact knowledge of its composition.

The first meeting in Swansea of this newly-constituted Section was held on November 10 in the Technical College. Capt. H. Vivian, the vice-chairman of the Section, presided, and Mr. A. Grounds read a paper on "Chemistry in Relation to Boiler-plant Efficiency."

Although the subject is one which has often been discussed before, the lecturer succeeded in putting some new points of view before the audience. Mr. Grounds emphasised that efficiency depended on (1) efficient combustion, (2) efficient transmission of the heat, and (3) retention of the heat, and he showed how different types of fuel have influenced the design of boilers. A very useful device for testing boiler-settings for air leakage was described; it consists of a lath frame one yard square covered with glazed linen, and provided with a small hole in the centre, opposite to which a lighted candle is fixed, supported on a cross-lath. When the frame is held flat against the brickwork any leaks are at once shown up by the movement of the candle-flame. A large area may be rapidly tested by this means.

In the discussion which followed, Capt. Vivian, Messrs. F. J. Bloomer, G. A. Phillips, and E. K. Regan took part. It was emphasised that records (carbon dioxide, draught, etc.) to be of any value must be as continuous as possible, and that it is the works-chemist's duty to interpret the results obtained; the Chemical Engineering Group might well pay attention to this matter. Some American figures quoted by the lecturer were questioned by Messrs. Phillips and Regan, who agreed that such figures (showing high overload tests) are often misleading when compared with British figures, as American boilers are usually much under-rated.

YORKSHIRE

An address on "Oxidation of Oils" was delivered by Dr. L. L. Lloyd, the chairman, at the meeting held in the Queen's Hotel, Leeds, on October 30.

Oils are classified as non-drying, semi-drying and drying; but these are only relative terms, as all vegetable oils harden on exposure to the atmosphere, the change being most probably caused by oxidation. The only true non-drying oils are mineral oils that have been subjected to special chemical purification. The hardening of oils is not entirely due to oxidation since most oils become harder on exposure to sunlight—this change being probably due to polymerisation. It has been shown that free fatty acids in oils oxidise much more readily than the glycerides; and that when once oxidation has commenced, it proceeds more rapidly. The oxidation of oils may be partly prevented or reduced by means of an antiseptic agent, such as potassium fluoride, such agents possibly preventing hydrolysis of the oils by bacteria or fungi, etc. In some cases oils become sticky on exposure to air, and in this condition are very difficult to emulsify, and consequently are deleterious in the textile trade. Many catalysts aid oxidation of oils, particularly rust, iron, copper oxide, or copper. Oils or their fatty acids, when oxidised, are difficult to remove from textile materials because their melting-points are above the temperature at which scouring is usually carried out, and for the purpose of emulsification fluidity is an essential property.

On November 20 Mr. R. A. Mott and Mr. H. J. Hodson read a paper on factors which influence the yield of ammonia in the carbonisation of coal, the work being a continuation of that published earlier this year (*cf.* J., 1922, 273 r). The previous paper had described the rôle of oxidation and the influence of water vapour, but the scope of the investigation was limited to temperatures below 800° C. This time the dissociation of ammonia in atmospheres of hydrogen, nitrogen, and coal gas was examined, especially the modification caused by the presence of small proportions of oxygen and water vapour. The latter has a very pronounced effect in restraining the decomposition of ammonia, and the remarkable observation was made that this effect was produced, though in a less degree, by oxygen itself in the presence of hydrogen, possibly by the water vapour formed. Even in the absence of water vapour the rate of decomposition varied according to the nature of the atmosphere. In studying the effect of contact materials it was found that well-used coke-oven brick impregnated with oxide of iron was much more active than new firebrick. This new brick was less active than the samples of coke tried. Fused silica and carbon deposited from hydrocarbons were very inert.

Mr. P. Wedgwood and Mr. H. J. Hodson read a note on the determination of the volatile matter in fuels. To obtain consistent results in the determination of the volatile matter in coal, it is important that the conditions shall be uniform. The platinum crucible is widely used in this determination, but its cost is an obstacle to its general adoption. An effective substitute should be metallic in character. Crucibles made from "monel" metal and iron treated with aluminium have been found reasonably satisfactory. Results obtained are usually about 0.5 per cent. lower than those obtained with platinum, and the crucibles are durable.

LIVERPOOL

On November 22 Mr. William Macnab delivered the Hurter Memorial Lecture in the Chemistry Lecture Theatre of the University. Dr. E. F. Armstrong presided over an audience of about one hundred, which included the Lord Mayor of Liverpool. On the motion of Dr. Armstrong it was resolved to send congratulatory letters to the chairman of the Section, Dr. G. C. Clayton, on his election to Parliament, and to Viscount Leverhulme and Sir Max Muspratt on having received "Dissolution" honours.

The late war produced a demand for enormous amounts of various explosives and chemicals, which led to the Government erecting many factories to supplement the output of private factories. The production of explosives in this country during the war period was:—Picric acid, 68,500 tons; TNT, 238,000 t.; ammonium nitrate, 378,000 t.; and cordite, 139,000 t. Toluene was in great demand for making TNT. A large distillery for handling the Borneo petroleum, which contains toluene and other aromatic hydrocarbons, was transferred from Holland to England, thus providing a valuable source of supply. Large works were erected at Oldbury and Queen's Ferry, the latter being able to produce 100 tons of TNT per day. Considerable quantities of synthetic phenol were produced from benzene, thus increasing the amount of picric acid which could be made. Great improvements were ultimately effected in the manufacture of picric acid. The output of sulphuric acid, as oleum, was increased enormously, the largest amount coming from Grillo plants. Cordite was also produced in large quantities, Gretna alone having a capacity of 1000 tons a week. The use of ammonium nitrate, mixed with TNT, as a filling charge for shells, led to a great development of its production; the largest amount was made by double decomposition of sodium nitrate and ammonium sulphate; a fine instance of the successful application of the phase rule.

In France, working under difficult conditions, owing to so many factories being in the hands of the enemy, remarkable efforts were put forth and splendid results achieved. Picric acid being the explosive most prized for French shells, and the supply of coal-tar phenol being totally inadequate, recourse was had to the manufacture of synthetic phenol from benzene. This manufacture developed until 200 tons a day was produced. The sulphonation of benzene in the form of vapour was carried out on the largest scale and proved a great advance on the old process. The production of propellant powder reached 370 tons per day. About 100 tons a day of nitrogen peroxide was made and used as chief ingredient in the explosive "anilite" employed in aeroplane bombs. Large works were erected for producing nitric acid from atmospheric nitrogen by the arc process; also from cyanamide and by the Kuhlmann-Ostwald process. When the submarine menace was at its worst arrangements were made for erecting additional plants to produce 500 tons of nitric acid and 150 tons of ammonium nitrate per day. At the time of the armistice some of these factories had begun to manufacture and the others were nearly completed. In this branch of chemical industry the French got much ahead of us, and still remain far in advance.

Both nations, France and England, may well be proud of their achievements in chemical industry.

In both countries, and also in America, this industry received a great stimulus during the war, and keener competition must now be expected from France and America, as well as from Germany.

We need more men like Hurter in our chemical industry. He may well serve as a splendid ideal for all of us. It is earnestly to be desired that professors and manufacturers who got to know one another better during the war—and others who are interested—will co-operate cordially in developing the best means of educating men who will be able to conduct our chemical industry in the most efficient and progressive manner, and thus enable all competition to be met successfully.

CHEMICAL ENGINEERING GROUP

The first of a series of papers to be given in London was read by Prof. J. W. Hinchley in the Chemical Industry Club on November 10, Mr. J. Arthur Reavell, chairman of the Group, presiding. Prof. Hinchley dealt with "The Dewatering of Peat by Pressure," and showed that much more water could be removed from peat by hot pressing than by applying nearly double the pressure in the cold. Views were shown of presses invented by the author for carrying out the hot pressing of peat, the heating being effected by blowing steam through the peat whilst in the press. By this means the author has found it possible to obtain a peat which on leaving the press contains from 57 to 45 per cent. of water, according to the nature of the peat treated. A further reduction of moisture is obtained by placing this pressed peat in a tunnel which is heated by waste gases from the furnace of the boiler required to generate the steam used in the press. A careful estimate of the cost of the process was submitted in which it was shown that the amount of dried peat consumed in the boiler furnace to generate the steam required for pressing was 25 per cent. of the peat pressed, and that the cost of this method of pressing varied from 17s. 6d. per ton in the case of a one-press plant to slightly less than 4s. 6d. per ton in a ten-press plant, and that it would be possible to sell dried peat at the factory at 15s. per ton.

The paper was followed by a discussion opened by Dr. R. Lessing, who asked what material was used as the filtering medium and if the chemical composition of the extruded water had been investigated. He also mentioned that some interesting work had recently been done in Norway on the composition of peat. Mr. P. Parrish inquired if the type of press described would be suitable for pressing the very friable peat found at Morwell in Australia. Mr. G. Radcliffe mentioned the preserving properties of peat and gave some interesting details of work which he had carried out on Irish peat. The possibility of using this type of press to de-water sewage sludge was raised by another speaker, and Mr. A. J. Broughall asked if vacuum drying was applicable, and if any consideration had been given to the presence of air bubbles on the edge of the cake, since these might retard the flow of water from the interior. The chairman mentioned the difficulty of obtaining equal pressure all over the cake and stated that a press had recently been invented to overcome this difficulty, and that some remarkable results had been obtained. In his reply Prof. Hinchley said that the question of securing a uniform pressure

was worth consideration; he had found a pressure of 500 lb. per sq. in. to be the most economical. The sides of the press consisted of tinned steel-wire gauze, which constituted the filtering surface. Most of his experiments had been made with peat from a depth of 3–8 ft., and for several reasons it was not desirable to utilise the lowest layer. He had not experimented with Morwell peat; and he did not think that the application of the centrifuge would afford a solution of the problem.

MEETINGS OF OTHER SOCIETIES

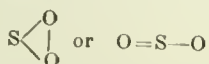
INSTITUTION OF RUBBER INDUSTRY

A meeting was held on November 6 in the Engineers' Club, London, at which Dr. H. P. Stevens read a paper on "Recent Developments of the Plantation Industry." The author dealt with the methods of tapping, collecting and standardising the latex, preparing the rubber in sheet or crêpe form, drying, milling, packing and transport.

The basic modes of preparing rubber are essentially the same as those adopted by the pioneers 20 years ago. It is now recognised that the severity of tapping affects the composition of the latex, and the intensive system is being replaced by tapping on alternate days or even or at less frequent intervals, *e.g.*, every four months. Latex is now collected in glass, glazed earthenware, or aluminium cups, instead of in tin cups and coconut shells, and sodium sulphite (1 part to 500 or 1000 of latex) is added to prevent coagulation before the latex is strained. Acetic acid is used as coagulant, the latex having been previously bulked and diluted in large tanks (small pans, if crêpe is to be made) in order to secure a product uniform in appearance and properties; usually the latex is diluted to a rubber content of 1.5 to 2 lb. per gallon. The rubber content of the latex is determined in the following way: the specific gravity is ascertained by means of a special form of hydrometer, and the rubber-content is found by consulting a graph showing the relation of the average rubber-content of the latex to the specific gravity; inaccurate results are obtained, however, if the latex shows any sign of pre-coagulation or thickening. Various improvements have been made in the houses used for smoking sheet rubber, mainly in the direction of providing increased accessibility, continuous working, and reducing the time of treatment. There has been no change in the method of preparing blanket crêpe, except that in Ceylon, hot-air or vacuum driers are frequently employed, drying in ventilated sheds being used in the Federated Malay States. For making thick crêpe, hot-air driers are now in use in the Malay States, as air-dried crêpe is hard and cannot be milled readily into blanket crêpe. Great care is taken to ensure that the rubber is dry before packing, but sheet rubber often shows traces of mould on arrival in Europe, owing to the presence in the rubber of water-soluble organic substances, particularly *l*-methylinositol, which is hygroscopic. Most of the impurities found in rubber by the manufacturer are due solely to contamination during unpacking, sampling and repacking, as rubber usually does not contain grit or dirt when packed.

THE PHYSICAL SOCIETY

At the meeting held on November 9, a paper on "The Structure of the Sulphur Dioxide Molecule" was submitted by Prof. A. O. Rankine and Mr. C. J. Smith. Viscosity data indicate that the actual mean collision area of the sulphur dioxide molecule is 0.94×10^{-15} sq. cm. Modern atomic theory leads to the conclusion that, in combination, oxygen atoms simulate neon atoms in size and shape, whilst sulphur atoms simulate argon atoms. The values of the mean collision areas of neon and argon are known from viscosity data, and the distances between the centres of atoms in combination are known from the crystal measurements of W. L. Bragg. It is thus possible to calculate the respective values of the mean collision area of the sulphur dioxide molecule, according as the molecular configuration is either



the latter configuration being suggested by Langmuir. Such calculation decides definitely in favour of the first structural formula, the respective calculated values being 0.99×10^{-15} sq. cm. and approximately 1.08×10^{-15} sq. cm.

In a paper on "The Thermal Effect of Vapours on Rubber," Mr. A. S. Houghton described briefly the heating effect produced when rubber is suddenly plunged into the vapours of chloroform, benzene, toluene, ether, water, and gases such as ammonia and carbon dioxide. It is probable that only part of the heat evolved is due to condensation of vapour on the rubber, the remainder originating in the formation of a compound or solid solution of a loose nature between the vapour and rubber.

Mr. J. T. Robin described and demonstrated an apparatus for determining the tensile strength of gas mantles. The method adopted is an application of Archimedes' principle, whereby owing to the gradual fall of level of water in a cylindrical tube in which a float is immersed, a gradually and continuously increasing load is applied to the "burnt-off" fabric of the mantle under test, until fracture of the mantle results. The value of the applied load at the moment of fracture of the mantle is read on a scale approximately calibrated.

THE CHEMICAL SOCIETY

Prof. J. F. Thorpe presided at the ordinary scientific meeting held in Burlington House, W., on November 2. There was a very good attendance, and a large number of papers was scheduled to be read. These were:—

The solubility and volatility of the nitrobenzaldehydes: N. V. Sidgwick and W. M. Dash; Investigations on the dependence of rotatory power on chemical constitution. Part XIII. The spatial configuration of the unbranched aliphatic chain: R. H. Pickard, J. Kenyon, and H. Hunter; Investigations on the dependence of rotatory power on chemical constitution. Part XIV. The normal aliphatic ethers of *d*- β -octanol: J. Kenyon and R. A. McNicol; Investigations on the dependence of rotatory power on chemical constitution. Part XV. The normal aliphatic ethers of *d*-methylbenzylcarbinol. Part XVI. A new type of Walden inversion: H. Phillips; Investigations on the

dependence of rotatory power on chemical constitution. Part XVII. The di-*d*- β -octyl esters of the acids of the general formula $(\text{CH}_2)_n(\text{COOH})_2$: L. Hall; Orientation of the 1:4- and 1:5-dimethylglyoxalines. Mode of fission of 5-aminoglyoxalines: F. L. Pyman; Bromo-derivatives of 2-methylglyoxaline: L. Light and F. L. Pyman; 2:5 iminodihydro 1:2:3 triazole. Part I. Constitution of Dimroth's 5-anilidotriazole: P. K. Dutt.

The papers, each of which dealt with particular instances of more general investigations, were presented, respectively, by Dr. Sidgwick, Dr. Pickard, Mr. Phillips, Prof. Pyman, and Mr. P. K. Dutt. An informal meeting was held on Thursday, November 16.

BRITISH ASSOCIATION OF CHEMISTS

The fifth annual meeting was held on October 28, Mr. W. E. Kay presiding in the absence, through illness, of the president, Prof. J. W. Hinchley.

The annual report of the Council refers to a decrease in membership; there are now 1095 members, compared with a nominal roll of 1344 at the commencement of the year. The adverse balance of £43 on the year's working would have been larger but for the response to the Council's appeal for supplementary donations. Accordingly, after considerable discussion, a resolution was carried at the annual meeting to raise the subscription to 30s. The report refers to the effect of the continued depression in trade on the activities of the Association, and particularly on the work of the Appointments Bureau. Nevertheless, the Council has been able to institute an Unemployment Benefit Fund, subscription to which is obligatory on all members holding salaried appointments. The Legal Aid Fund continues to help members in regard to service agreements, etc., and in securing rebate from income-tax for professional expenses. Negotiations have been carried on with the National Union of Scientific Workers with a view to closer co-operation or amalgamation, and two joint council meetings have been held for the discussion of common policy and activities. The Council has also considered the question of terminating the "B" qualification for membership of the Association, legal re-definition of the term "chemist" and other matters affecting the status and professional efficiency of the chemist. The Association is registered under the Trade Union Acts and membership is open to both employers and employees.

Speaking at the annual dinner, Dr. H. Levinstein, the new president, said that, with adequate organisation, the Association could be made to include practically all the chemists in the country, as did the Institute of Chemistry, whose functions were complementary to those of the Association. The chief, but a very great, difference between an ordinary trade union and a trade union of chemists was that the employers of chemists were just as interested in raising the status of chemistry as the chemist himself. Collective bargaining to secure minimum fees or salaries was, he believed, a retrogression rather than an advance, but such questions as the stabilisation of remuneration and rewards for patents could readily be discussed with a body of employers like the Association of British Chemical Manufacturers, and educational matters with university authorities. Dr. E. F. Armstrong also spoke.

NEWS AND NOTES

BRITISH INDIA

Tata Oil Mills

The *Times Trade Supplement* for November 11, 1922, publishes an abstract from the report of the Tata Oil Co., which shows that for the fifteen months ended March 31, 1922, a loss of Rs. 14 lakhs was incurred. A report issued by the company in 1921 disclosed a loss of Rs. 20 lakhs. The directors put forward several reasons for these heavy losses, including the collapse of the overseas markets since the mill started work, making it impossible to operate either continuously or at full capacity; the heavy fall in the price of coconut oil from £121 in 1920 to £37 in August, 1922; and particularly, the heavy duties which America has imposed against all foreign oils in favour of similar oils from "its own colonies"—presumably the Philippines—for it was hoped to dispose of much of the output of the mills in America.

The position in which this company finds itself, after less than two years of actual operation, stands out in vivid contrast to the situation in India during the amazing boom period of 1919-1920. In Bombay particularly, the name "Tata" at the head of a new company-prospectus was sufficient in the eyes of the Indian speculator to render ordinary shares—perhaps not unjustifiably—equivalent to gilt-edged securities. In the spring of 1920, before the oil mills had produced a single ounce of coconut oil, the original Rs. 100 shares of the company stood at Rs. 600, and probably no other newly-founded Indian industrial concern attracted so much interest or was launched with greater confidence in its future.

The policy underlying the formation of the Tata Oil Mills Company is characteristic of the Tata group of capitalists, namely, to develop manufactures as far as possible in India itself instead of acting merely as trading concerns engaged in the collection and export of raw material. The Malabar Coast region, which is one of the finest coconut-producing areas in the world, offered a particularly attractive field for new enterprise. Before the war the whole output of copra, apart from the relatively small proportion consumed locally, was exported, chiefly to Europe. In 1914 about 38,000 tons was shipped, and of this amount 75 per cent. was taken by Germany. The only crushing plant in the Malabar country consisted of the primitive native chuck-mills and a few small steam-driven mills constructed on the same principle.

The Tata Mill was erected at Enakulam, on the Cochin Creek, a particularly advantageous site, since it lies in direct communication with the sea and with the long line of backwaters which stretch north and south throughout the coconut area and afford very cheap means of transport for copra and other coconut products. The Government intends to construct a harbour at Cochin which will allow the products of the Mill to be loaded directly on to the ship; at present the Malabar coast possesses no harbour, and the cost of intermediate transport is a considerable disadvantage for traders in that region. Enakulam is also connected by rail with all parts of India.

The mill was equipped entirely with American plant and was erected under the supervision of

American engineers who had had experience in the Philippines, where the copra-crushing industry has been developed with marked success. The capacity of the factory is about 100 tons of copra per day. The present writer, in the course of a visit to the Malabar coast during 1920, was particularly struck by the interest shown in the new enterprise on the part of the native population, which certainly looked forward to an era of prosperity as a result of this development of an industry on which it depends almost entirely for a livelihood.

In view of the resources of Malabar in respect of coconut products, the unique combination of advantages which the situation of the mill affords, and the fact that the company is controlled by a group of men who have shown remarkable business acumen and foresight hitherto, it is difficult to believe that the present unfavourable position of the company can be other than temporary.

Crop Forecasts.

Groundnuts and Sesamum.—Reports received from provinces comprising 99 per cent. of the area under groundnuts in British India indicate that the acreage under the crop has increased by 24 per cent. to 1,846,000 acres (first forecast). The second forecast of the sesamum crop sown in provinces containing 99·6 per cent. of the total area under the crop (including Burma, but excluding the "mixed" crop in the United Provinces and the late crop in Bengal and Madras) gives the area sown as 3,432,000 acres; excluding Burma, the estimated area is 2,595,000 acres, or 4 per cent. below the corresponding estimate of last year. The present condition and prospects of the sesamum crop are reported to be good.

Sugar-cane.—The second forecast of the area under sugar-cane estimates the acreage under the crop at 2,460,000, a decrease of 1 per cent. compared with the estimate at the same time last year and an increase of 3 per cent. over the final estimate of last year. In general the condition of the crop is good. The forecast relates to provinces containing 99 per cent. of the total area under sugar-cane in British India.—(*Ind. Tr. J.*, Nov. 2, 1922.)

AUSTRALIA

Beet-Sugar in Victoria

During 1921-22 the State beet-sugar factory at Maffra, Gippsland, treated 16,578 tons of sugar-beet from 1500 acres, and produced 1872 t. of sugar. The average sugar content was 11·3 per cent., and 8·55 t. of beet yielded 1 ton of sugar, as compared with 9·745 t. in 1918-19 and 12·348 t. in 1910-11. For each ton of clean beet 45s. was paid, and after allowing for interest and depreciation the year's working showed a profit of £9920. New machinery is to be installed in the factory which will more than double its capacity and ensure more economical working. It is anticipated that the beet crop will also be doubled, especially as the Glenmaggie system of irrigation renders the growers independent of the rainfall to a large extent. Compared with the consumption of sugar in Victoria—approximately 75,000 t.—the output of the factory is small, but the industry offers prospects of extension, as the cost of production is about the same as that of cane, and the sugar content is gradually improving.—(*Ind. Austr.*, Aug. 31, 1922.)

FRANCE

Industrial Notes

Chemical Industry.—In the *Revue Scientifique* for October 28, Professors Béhal, Haller and Mouren review the present position of the French chemical industry, and especially the organic-chemical industry, in relation to the general economic crisis. Chemical manufacture in France, particularly that of organic products, is declining gradually to the pre-war level owing to the severe German competition made possible by the depreciation in value of the mark. For this reason the difference between German and French cost prices is so great that many French factories are contemplating closure unless assistance is obtained. Apart from the advantage due to depreciated currency, production costs are lower in Germany because almost all the raw materials of chemical industry are produced locally, and the factories outside the war-zone are of recent date and magnificently equipped. In France, however, labour and raw materials cost ten times as much; in certain areas the plant has been destroyed or damaged, and the remainder has to be brought up to date. The French industry is protected by a heavy tariff wall, but this can be evaded either by false declarations of origin or by having the material transformed in a foreign country before it is imported into France. This state of affairs appears all the more deplorable in view of the great strides made by France during the war to become self-supporting in respect of supplies of organic chemicals. At present France can not only meet the home demand for pharmaceutical and photographic chemicals, and synthetic perfumes, but is producing 85 per cent. of the requirements in dyes and intermediates. In addition, well-equipped research laboratories have been established, and the courses in the various schools of chemistry have been attended by large numbers of students, but, unhappily, these cannot find employment, and their distress does not encourage others to follow the profession. The authors appeal to the Government to act before it is too late by initiating a strict control over imports of organic chemicals. They emphasise the commanding position held by chemical industry in the life of every nation, and point out the grave error committed in certain quarters of seeking a temporary advantage by trading with Germany, instead of supporting the national industry.

A proposal has been made to establish a Cellulose Research Institute, comprising an intelligence department, provided with all the relevant literature, and five research laboratories for investigating the preparation of cellulose, bleaching and dyeing cellulose and artificial silk, production of artificial silk for preparing nitrocellulose, cellulose acetates and formates, aeroplane "dope," and the last for research on the manufacture of celluloid. Such an institute would be of value to the French colonies, as great interest is now being taken in utilising "alfa" from North Africa and similar colonial products.

Metallurgy.—Production remains good in the various mining areas, except near the Pyrenees. In Normandy and Anjou, manufacturers are finding new markets in England and Germany, and important contracts are being considered. Home consumption is progressing, and if supplies of German coke were steadier, more blast furnaces

could be blown in. Generally, the metallurgical situation remains unaltered, but with a slight tendency to diminished consumption.

An important meeting has been held by the *Conseil Supérieur* recently formed to co-ordinate all railway transport, and the question of revising railway rates was discussed. A reduction of these rates is held to be long overdue. At present most of the metallurgical firms near the eastern frontier find it cheaper to export their products *via* Holland and Belgium. Recently a railway company had a consignment of rails made in Belgium shipped to an Atlantic port, rather than transport it by land over the French Eastern Railway.

UNITED STATES

"Journal of Physical Chemistry"

As previously announced, the above-named journal is to be published under the joint auspices of the American Chemical Society, the Chemical Society of London, and the Faraday Society, and the following chemists have now been appointed to the editorial board:—Professors T. M. Lowry, J. W. McBain, and J. C. Philip (Chemical Society of London); Prof. F. G. Donnan (Faraday Society); Dr. A. L. Day, Prof. G. A. Hulett, Dr. Irving Langmuir, and Prof. W. Lash Miller (American Chemical Society). The board will shortly elect an editor-in-chief.

The Perkin Medal, 1923

Dr. M. C. Whitaker, the next recipient of the Perkin Medal (*cf.* p. 512 n of this issue) was chairman of the New York Section of this Society in 1922, and president of the American Institute of Chemical Engineers from 1914 to 1916. In 1914 he organised the Department of Chemical Engineering at Columbia University and became its head. During his management of the Welsbach Company's factory, from 1903 to 1910, the output of the plant was more than doubled and the cost reduced by more than one-half. In 1916 Dr. Whitaker became manager, and in 1917 president, of the Curtis Bay Chemical Co., now the U.S. Industrial Chemical Co., which at that time made only acetone; now it is the largest producer in the United States of alcohol motor fuel, absolute alcohol, normal and iso-propyl alcohols, isobutyl alcohol, diethyl phthalate and many other fine chemicals. Eight of this company's products are made by new processes which have been worked out and put into operation under Dr. Whitaker's direction.

Chemists in American Public Life

A survey was recently made of the part that chemists play in the public life of their communities in America. On the whole it showed a general tendency among chemists to take interest only in such affairs as concern their personal welfare, and that few chemists are office holders. In one western city, Tacoma, Wash., a chemical club formed a committee to co-operate in civic affairs; but there is one city in Michigan, the seat of a large chemical industry, that is a truly chemical city. Only fifty-five out of its population of 5500, or 1 per cent. are chemists, but in spite of this proportion the chemists have this record: For six years, the mayor and three out of eight aldermen have been chemists; one chemist is on the school board; ten are in the Chamber of Commerce; and sixteen in the Kiwanis

Club, a "better community" organisation. There is one real chemist in the United States Senate, viz., Dr. Edwin F. Ladd, the junior senator from North Dakota. He has been active in the chemical laboratory for thirty-six years and as chief chemist of North Dakota for twenty years he waged a winning fight for pure foods and materials. During this work of law enforcement he learned the ways of legislation and legislatures. He is particularly interested in urging in the Senate such measures as those providing for the adoption of the metric system, the compulsory working of patents, and the setting up of purity standards for paints.

Storage of Portland Cement

The U.S. Bureau of Mines, in studying the storage and transportation of Portland cement, has found that, owing to the smaller area exposed, the cement stored in bulk deteriorates less than when stored in bags, hydration taking place only on the exposed surface. Cement transported in bulk must be shipped in a tightly closed car, and must be protected from moisture during loading, shipping, and unloading. This method of transport dispenses with the use of the costly bags and permits a saving in freight rates in the United States.

Gasoline Consumption by Motor Cars

In the October issue of the *Journal of Industrial and Engineering Chemistry*, Prof. G. G. Brown, of the University of Michigan, asks: "Can we afford the Ford?" He declares that his researches have shown that the Ford automobile touring car, driven under average conditions, runs not more than 17.5 miles per gallon of gasoline and that it should give 24 miles per gallon. One cause for this inefficiency is the present carburetting system, which can be so improved that the average Ford car will give 25 miles per gallon and operate as economically as more expensive cars. Of the 11 million motor vehicles in the United States about 5 million are Fords, which, it is estimated, consume one-fourth of the total gasoline production of the country. If a chemically controlled carburettor, such as that designed by Prof. Brown, were used, 400 million galls. of gasoline, worth \$100,000,000, would be saved annually. Mr. Ford could buy a Muscle Shoals every 18 days with the savings made by improving the carburetting system on his cars.

CANADA

Pulp and Paper

President Dodge, of the International Paper Co. of America, stated recently that many of the company's mills in the United States would eventually be converted into power plants. This statement may be regarded as a forecast of the possible disappearance of the U.S. newsprint manufacturing industry in the face of Canadian competition, assisted by the continued rapid depletion of pulpwood supplies in the Eastern United States. The total production of newsprint in the States during 1920 was 1,511,000 tons, whilst 15 mills in Canada have a present capacity of over one million tons. The development of the pulp and paper industry in Canada is exceedingly interesting. In 1891 the exports were valued at \$120, and in 1921 at \$163,655,344. During the last decade the increase in value of exports has been very marked: in 1912, \$8,980,184; 1915, \$27,107,697; 1920, \$104,635,388.

Petroleum

The tar sands of Alberta are occupying much attention, but it is quite clear that many of the proposed methods of utilisation are not economic. The latest method is one developed by the research department of the University of Alberta. The press account of the process, which is all the information available at present, is not sufficiently explicit to justify the expression of any opinion regarding its practicability.

The chief interest in petroleum development in Canada is now concentrated in the Sweetgrass District of Southern Alberta, where, owing to the strikes across the line in Montana, many wells are being drilled. Coutts, a small town south of Lethbridge, is the centre. Many prospectors from Texas, Wyoming, Louisiana, California and other parts of the States are operating in this district, but the latest arrivals include representatives of British financial interests. Many wells are being sunk; the deepest is down 2100 ft., but oil is not expected above 2500 ft. The Imperial Oil Co., Ltd., is drilling six wells in Alberta, but, so far, no useful discovery has been made. The well at Pouce Coupe is down 2612 ft., and there is a flow of 10 million cb. ft. of gas a day. The Fabyan well, at 2600 ft., has also a strong flow of gas. The others are barren of results. Drilling is being continued in the Fort Norman district, on the Mackenzie River.

RUSSIA

Pharmaceutical Chemicals

In June, 1922, eight factories were producing pharmaceutical chemicals, and the intended output was realised. The output included 826 cwt. of medicinal preparations, 514 cwt. of disinfectants, 185 cwt. of soap, and 391 cwt. of various preparations. Production, especially that of ether, is much hindered by the duty levied on alcohol.

Metalliferous Mining in 1922

Ore-mining in Russia is in a bad condition. Even in the Krivoy-Rog, formerly the greatest ore-producing region, only three mines are working, with a monthly output of 11,700 long tons, which is a poor figure compared with pre-war production. Stocks in hand amount to 1,354,000 tons, largely remaining from pre-Bolshevist days. Although production was continued during the first years of Soviet rule in the Tula and Kaluga district, it was stopped last winter and only just recently have steps been taken with a view to resumption. The production achieved has not been large, as this district, like that of Krivoy and also Lipetsk, is in a state of "technical conservation," probably a Bolshevist euphemism for a state of decay. In the Oka district only the Tischinsk mines are at work, the May production being 161 tons.

Production is better in the Ural region, where the Tschinsk mines have a monthly output of 3609 tons, which is 12 per cent. more than the estimate. The Bakalsk mines have the next largest output with 1873 tons, or 73 per cent. of that anticipated.

The Nikopol manganese mines produced in May 2323 tons of ore, i.e., 57 per cent. of the estimated amount. Stocks of manganese ores amount to 137,000 tons. Copper-mining has been practically at a standstill since 1918, and only recently have

efforts been made to revive it; during this year the production has been 2705 tons. The most important zinc and lead mines are at Alagir, in the Caucasus, where in 1920 and 1921 about 600 tons of lead and 200 tons of zinc were produced. The Siberian zinc and lead works are not yet completed. The winning of asbestos has been carried on by the recently formed trust, "Ural Asbestos." This year's production amounts to 1196 tons, and stocks in hand to 16,000 tons.—(*Prawda* [Moscow], No. 184, 1922.)

GERMANY

"Reparation" Dyestuffs

The dyestuffs delivered by Germany under the Treaty of Versailles up to May 1, 1921, were valued at 32,476,000 gold marks and from that date to June 30, 1922, at 10,708,000 gold marks. Deliveries were distributed as follows:—

	To May 1, 1921	May 1, 1921— June 30, 1922	Per cent. of total
	1000's of gold marks	1000's of gold marks	
Belgium ..	2,949	3,221	14.3
British Empire ..	8,499	1,606	23.6
France ..	9,251	2,006	26.0
Greece ..	—	196	0.5
Italy ..	9,121	3,589	24.9
Japan ..	2,630	—	6.1
Yugoslavia ..	23	—	0.1

In addition to the above deliveries, dyestuffs valued at 4 million gold marks were sold to the Textile Alliance of the United States through the Reparation Commission, which also re-sold dyestuffs valued at 3 million gold marks to German buyers.—(*U.S. Com. Rep.*, Oct. 23, 1922.)

Denatured Spirit for Medicinal Use

In reply to a petition, presented by representatives of the hospitals, for a reduction in the price of spirit, the Prussian Ministry of Welfare (*Volkswohlfahrt*) stated that the price for use in public hospitals would be reduced by means of a yearly grant not exceeding 40 million marks from the alcohol-monopoly tax, but that the mode of distributing the grant had not been decided. For many purposes, such as disinfecting and dressings, hospitals could economise by substituting a suitably denatured spirit for pure spirit. It was proposed to make available a cheap spirit denatured with diethyl phthalate, which possessed such a bitter taste that it could not be taken internally, although it could be used safely for disinfecting the skin and in preparing alcoholic medicaments for external application.—(*Chem. Ind.*, Sept. 25, 1922.)

Acetic Acid and Industrial Alcohol

Official statistics record that in 1920 acetic acid was manufactured in twenty factories, of which eleven utilised acetate of lime as raw material, five calcium carbide, one pyroligneous acid, and three various other raw materials. Industrial alcohol was made in only four factories, the output of 663 metric tons comparing with 8 t. from five factories in 1919 and 109.7 t. from eight factories in 1914. The great increase in 1920 was due to the renewal of demand from industries using alcohol whose production had been restricted during and after the war. The industrial use of undenatured acetic acid has also greatly increased; figures of production have not yet been issued. Prices of acetic acid rose from 90 to 105 marks per quintal for 80 per cent. acid in 1913 to 600—1800 mk. per quintal for 80 to 100 per cent. acid in 1920.—(*Chem. Ind.*, Oct. 2, 1922.)

The Production of Gas and Crude Tar from Lignite

In No. 243 of the "Forschungsarbeiten auf dem Gebiete des Ingenieurwesens," Hilliger and Wurm record the results of a number of tests carried out to discover an economical process for the production of gas and tar from lignite. The results show that in the present position of the distillation process and with the present price-ratio for lignite and lignite tar, direct distillation affords an economical method of utilising lignite.

Cement from Blast-furnace Slags

Unsuccessful attempts to convert acid blast-furnace slags into cement by fusing them with lime have been made for some time past. The increasing scarcity of building materials and the production of very large quantities of the slag have once again turned the attention of chemists to the problem of its utilisation, and two processes have been developed which have given promising results. Wennerstrom's method consists in heating by electrical means the slag with lime in a graphite-lined circular furnace, whereas R. Griin first converts the slag into a basic compound by adding alumina to the charge either before, or simultaneously with, the lime. The alumina reduces the melting point of the mixture and enables it to take up more lime. The resulting product when finely ground with clinker makes a good cement.

GENERAL

The British Empire Exhibition, 1924

Active preparations are being made for this Exhibition, which will be held in Wembley Park, London, from April to October, 1924. As the title implies, the function of the Exhibition will be to bring together all parts of the Empire: to bring markets to producers, and goods to buyers. The whole Empire will be represented at Wembley, and the space already booked by Greater Britain is nearly seven times that which it occupied at the exhibition held in the White City in 1908. Wembley Park, it may be remarked, is within 10 minutes ride by railway from Baker Street and Marylebone, and there are 126 railway stations within the London area from which the Exhibition may be reached in an average time of 18 minutes. Exhibits will be arranged in 10 sections, 45 groups, and 150 classes. All raw materials and manufactured goods to be shown must have been produced within the Empire, and applications for floor space must be in the hands of the General Manager (16, Hobart Place, London, S.W. 1) by December 30, 1922. The chemical exhibits will be displayed in Section E, Manufactures: Group XXVI, Chemical Industries, Dyestuffs and Perfumery; other materials of interest to chemists will be shown in the same section under Group XXIII, Metal Industries; Group XXIV, Textiles; Group XXIX, Miscellaneous Industries (including pottery and glass, oilseed products, and rubber). Plant and apparatus used in the chemical industry will be shown in Section D, Machinery and Implements, Group XX. The organisation of the sections covering chemistry, pure and applied, has been entrusted to the Association of British Chemical Manufacturers, with which the Society of Chemical Industry is co-operating actively. Members of the Society are invited to visit Wembley Park to inspect the grounds and the buildings in course of erection, but for this purpose they must first obtain tickets from the General Secretary at Central House.

PERSONALIA

Sir Robert Robertson has been elected president of the Faraday Society.

Mr. D. H. Peacock has been appointed professor of chemistry in the University of Rangoon.

Dr. F. Gianformaggio has been appointed professor of chemistry in the Technical Institute, Syracuse.

Dr. P. Fischer has succeeded Dr. Agde in the chair of chemical technology in the Polytechnic at Cöthen, Germany.

The Perkin Medal of the American Section of this Society has been awarded to Mr. Milton C. Whitaker, vice-president and manager of the U.S. Industrial Alcohol Co., and will be presented to him on January 12, 1923.

Prof. M. Bodenstein has been invited to accept the chair of physical chemistry in the University of Berlin, held formerly by Prof. W. Nernst, who is now president of the Physikalisch-Technisch Reichsanstalt and honorary professor in the University.

Mr. W. B. Wiegand, M.A., of Montreal, chairman of the Rubber Division of the American Chemical Society, has been appointed general manager of Ames-Holden-McCready, Ltd., large manufacturers of tyres and other rubber goods.

Prof. G. T. Morgan, professor of chemistry in the University of Birmingham, has been awarded the Research Medal of the Dyers' Company for his paper on "The Co-ordination Theory of Valency in relation to Adjective Dyeing," which was read last year before the Society of Dyers and Colourists.

The honours bestowed on the occasion of the resignation of the Ministry include a viscounty to Lord Leverhulme, for public services, and a baronetcy to Alderman Max Muspratt, chairman of the United Alkali Co., Lord Mayor of Liverpool, 1916-17, who rendered great service during war in trench warfare.

The following were among those elected members of the House of Commons at the General Election, held on November 15-16:—Major W. A. Bowdler, of Church, Accrington (Holdersness, Yorks, East Riding); Dr. G. C. Clayton, a director of the United Alkali Co. (Widnes); Mr. C. S. Garland (South Islington); and Sir Alfred Mond (Swansea West). The unsuccessful candidates included:—Sir John Brunner, Bt.; Major A. G. Church (secretary, National Union of Scientific Workers); Sir William Pearce; and the Rt. Hon. J. W. Wilson. Mr. W. J. U. Woolcock, general manager of the Association of British Chemical Manufacturers, and Col. Sir Edward Brotherton did not seek re-election.

We regret to note the death, on November 26, of Mr. Harry J. Powell, late of the Whitefriars Glass Works, in his 70th. year.

Dr. H. Larouche, director of the Civic Laboratory and assistant professor of chemistry in the University of Montreal, died suddenly on August 16, aged 33 years.

The death is reported of L. Tschugaeff, professor of inorganic chemistry in the University of Petrograd, from typhus fever, at the age of 50 years. The deceased is, perhaps, best known for his discovery of the method of determining nickel with dimethylglyoxime.

REPORTS

REPORTS ON CINCHONA BARK [AND MYROBALANS].
Reports of the Indian Trade Inquiry, Imperial Institute. Pp. 59. London: John Murray, 1922. Price 4s. net.

Cinchona was introduced into tropical British possessions about 1860, and within twenty-five years Ceylon became the chief source of supply of the bark, yet at the present time Java produces annually about 23 million lb. of bark, or about 90 per cent. of the world's supply, whilst the production in India is only about 2 million lb. (4 million lb. in 1899-1900) and that of other countries about 400,000 lb. Although "druggists' bark" is exported from India, most of the Indian-grown bark is worked up for quinine factories; further, as all of the quinine produced is used in India and both bark and quinine are imported, India cannot be regarded as an immediate source of exports of cinchona bark for quinine manufacture. In fact, to quote the words of the report, "The most striking feature of the trade in cinchona bark is therefore the virtual monopoly held by Java; a monopoly which, moreover, has been secured at the expense of Ceylon and India, and which makes the British Empire ultimately dependent on a foreign country for the raw material from which the essential drug quinine is made."

This position is obviously serious, especially when the hazards of war are taken into account, and when it is realised that the Empire requires an annual supply of about 8 million oz. of quinine, equivalent to about 8½ million lb. of bark of average Java quality.

The position is complicated further by various agreements made between Java planters and manufacturers of quinine; although full details of these arrangements have, apparently, never been made public, the present agreement—which remains in force until July, 1923—affects only quinine manufacturers in Java and Holland who have agreed to take bark equivalent to 575,000 kg. of quinine sulphate annually, which was the quantity allocated under an earlier agreement to quinine manufacturers throughout the world. Whether quinine manufacturers in other countries will be able to obtain supplies of bark is uncertain, though it is stated that the single quinine factory in this country "has been partially safeguarded by an arrangement made, it is understood, at the suggestion of H.M. Government," under which supplies will be obtained during the next ten years from British-owned plantations in Java which are not now parties to the contract, and which have an estimated output of about 9 per cent. of the total for Java. Certain Dutch plantations in Java are also said to be standing out of the contract and to have arranged to supply bark to Japan, where quinine manufacture was started after the commencement of the war. According to Lt.-Col. A. T. Gage, I.M.S. (*Rept. Extension Cinchona Cultiv. in India*), large extension of cinchona in the areas in India where it is already grown is not possible, but other areas are suitable, e.g., in Northern Tavoy, Burma. In British Malaya also it seems that cinchona might be grown successfully, as the trees on 20 acres planted with *Cinchona succirubra* and *C. Ledgeriana* at Gunong Angsi, Negri Sembilan, in 1914 were making excellent growth three years

later. The question of establishing plantations is being considered by the F.M.S. Government, and areas of suitable land have been reserved pending a decision.

Reports on a number of samples of bark from St. Helena, the Cameroons, and the Tanganyika Territory, examined at the Imperial Instituto and submitted to brokers and to manufacturers of quinine, show that bark of good quality may be produced, but it is doubtful if these countries will yield commercial supplies of bark in the near future.

The Javan monopoly of cinchona bark is evidently very important to other nations, and it is said that quinine manufacturers in the Allied countries and the United States have formed an Association to watch the position and safeguard their interests, and that a special American mission has investigated the possibilities of Colombia as a source of supply. Experimental plantation of cinchona in Japan and the Philippines is said to have been undertaken and arrangements made for quinine manufacture in Brazil and Peru from locally grown bark.

Provided that supplies of bark can be assured, the manufacture of quinine does not appear to offer difficulties, as the Government factories in India seem to have been financially successful, and a second factory which existed formerly in the United Kingdom was so successful—especially in the quinine export trade—that it was taken over by German manufacturers and subsequently closed.

In 1916 the Bandoeng factory in Java treated about one-fifth of the output of bark and for many years has been most successful. The exports of quinine sulphate from Java rose from 2,556,887 oz., valued at £120,845, in 1913, to 4,572,123 oz., worth £546,621, in 1917.

Appended to the report are useful statistics of production of, and trade in, bark and quinine in the chief producing and consuming countries.

REPORT ON THE ECONOMIC AND COMMERCIAL SITUATION OF AUSTRIA, TO JULY, 1922. By O. S. PHILLIPOTS, *H.M. Commercial Secretary, Vienna. Department of Overseas Trade. Pp. 57. H.M. Stationery Office, 1922. Price 1s. 6d.*

The economic plight of Austria is too well known to need description. Failure to restore agricultural production has proved most serious; the country is unable to buy food from abroad, and fertilisers cannot be imported because farmers have to sell their products at less than world prices.

In 1921 production of iron ore improved by 251,036 tons to 679,536 t., and that of pig iron by 116,274 t. to 214,322; the figures for the first quarter of 1922 are 216,868 t. and 60,071 t., respectively; supplies of coke were obtained from Czechoslovakia and England, but lack of labour limited the output. The output of coal was 2,607,000 t. and importations from Upper Silesia, Czechoslovakia, and Poland amounted to 5,928,000 t. Slightly more magnesite (120,000 t.) was mined, but the production of salt was only 78,100 t. (160,000 t. in 1913), owing to the cost of coal for evaporating the brine. Development of the available water-power has been slow, but 24 works with a total capacity of 99,400 h.-p. were under construction in 1921 and other schemes have been started since. Most industries working for exportation were very busy during the second half of 1921, but

trade fell off greatly when the value of the krona ceased to fall and severe German competition became possible owing to the depreciation of the mark. Although the effect of this slump has been partly overcome, the outlook is unfavourable on account of the shortage of working capital, the fluctuating exchange, foreign (chiefly German) competition, prohibitive tariffs in adjacent countries, high wages, and labour troubles.

The total weight of exports in 1921 was 1,477,402 t. and of imports 8,175,736 t., leaving an unfavourable trade balance of 6,698,334 t., compared with 4,744,000 t. in 1920. The value of the foreign trade is not known exactly, but it is estimated that the exports and imports in 1921 were worth £35,000,000 and £62,800,000, respectively. The share of the United Kingdom in the import and export trade is still very small, under 1 per cent. of the total quantity; skins, fatty oils, coal, wolfram ore, china clay, rubber, tin, caustic soda, varnish and colours were imported from this country in greater quantity. Importations of copra, fats, photographic plates, pig iron, ferro-silicon, etc. and chemicals declined. Among the exports of chemical interest sent to the United Kingdom were magnesite, talc, wood pulp, cement, glassware, and calcium carbide.

REPORT ON THE ECONOMIC AND INDUSTRIAL CONDITIONS IN THE SERB-CROAT-SLOVENE KINGDOM, DATED MAY, 1922. By CAPT. E. M. HARVEY, *H.M. Commercial Secretary, Belgrade. Department of Overseas Trade. Pp. 31. H.M. Stationery Office, 1922. Price 1s.*

At the beginning of 1921 conditions in Yugoslavia were promising, but later in the year, when control over the exchange was removed, the currency depreciated rapidly; this, combined with the inadequacy of the railways, greatly hindered trade. Drought seriously affected agriculture, which finds employment for 80 per cent. of the inhabitants. Apart from staple agricultural products, commercial and industrial herbs, such as pyrethrum, rosemary, sage, sumac, belladonna, gentian, etc. are grown in Dalmatia, the opium poppy is grown in Serbian Macedonia, and tobacco in Bosnia, Herzegovina and Macedonia. Progress was made in textiles, but other industries did not prosper, the leather industry in particular suffering from severe competition from Austria and Czechoslovakia. Many new industrial undertakings, mostly on a small scale, are springing up, and development will be rapid when means of communication are improved. German capital is said to be interested in many of these new industries. Development in the mining industry awaits improved transport. A British company has acquired a valuable lead mine in Slovenia, and a coal mine in Croatia is being worked by British enterprise. Oil-boring operations are in progress in Croatia in the district between the rivers Save and Drave; and the Government has shipped to Germany a large quantity of iron ore from the Ljubija mines in Bosnia. In 1921 the production of coal was 63,940 tons, of soft coal 2,651,108 t. and of lignite 103,064 tons.

Imports during the first half of 1921 were valued at 2,093,525,548 dinars; they included chemical and pharmaceutical products, colours, varnish,

ethers, alcohols, essential oils, artificial grease, and explosives worth 102,024,271 dinars, glass and glassware 43,141,660 dinars, wax and wax products 34,419,171 dinars, metals and metal products 236,546,955 dinars, and minerals and mineral oils 118,458,462 dinars (dinar=9.5d. at par; av. value during 1921, 0.8d.). The origin of the imports was (per cent.):—Austria 25.45, Italy 21.85, Czechoslovakia 19.75, Greece 7.16, and Great Britain 6.59. Probably a large proportion of the imports from Greece was of British or French origin. During the whole year Great Britain supplied goods valued at £1,045,705. Trading with Great Britain is hampered by the fluctuating exchange, but as German and Austrian firms are beginning to quote in sterling for certain products, *e.g.*, steel, the advantage derived from depreciated currency is apparently disappearing. Exports during the whole year were valued at 2460.7 million dinars, of which 35.86 per cent. went to Austria, 23.43 per cent. to Italy, and only 0.72 per cent. (£759,542) to Great Britain.

LEGAL INTELLIGENCE

THE PHOSPHORIC-ACID CONTENT OF UNGROUND BASIC SLAG. *Le Manufacture d'Engrais et de Produits Industriels v. T. W. Ransom, Ltd.*

In the King's Bench Division on November 9, Mr. Justice Greer heard an appeal by *Le Manufacture d'Engrais et de Produits Industriels*, Antwerp, against an umpire's decision in favour of *T. W. Ransom, Ltd.*, Manchester. The latter company claimed that a contract to buy unground basic slag from the Belgian company stipulated that the slag should contain from 17 to 20 per cent. of phosphoric acid. Slag containing 11 to 17 per cent. of phosphoric acid was offered, but the English company refused it, contending that the slag should contain approximately 18 per cent.

For the Belgian company it was submitted that at least 11 per cent. of total phosphoric acid would have to be present in the bulk so that the solubility prescribed in the contract could be reached, and that the company was entitled to deliver unground slag containing any percentage of phosphoric acid, provided that the guaranteed solubility of 75 per cent. was not infringed. The umpire found that there was no necessary relation between the contents of total and of soluble phosphoric acid present in the bulk of the slag. In giving judgment Mr. Justice Greer said that the foregoing fact was known to the trade and the umpire was entitled to decide that "18 per cent. basic slag" meant that the content was 18 per cent. or thereabouts. He therefore decided in favour of *T. W. Ransom, Ltd.*, with costs.

GOVERNMENT ORDERS AND NOTICES

"REPARATION" DYESTUFFS.—The Board of Trade announces that a list of the products comprised in the stocks of "reparation" dyestuffs is now available. The list, together with any further information relating to these stocks, may be obtained on application to the British Dyestuffs Corporation, Ltd., Reparation Department, 70, Spring Gardens, Manchester.

COMPANY NEWS

BRITISH SULPHATE OF AMMONIA FEDERATION, LTD.

At the second annual general meeting, held on November 16, Mr. D. Milne Watson, chairman, said that conditions had improved during the past year and that deliveries had not kept pace with the demand. The average price obtained was disappointing, on account of high costs, the price of sulphuric acid alone being more than twice that of pre-war times. There would have to be a great reduction in the price of acid if the cost of producing ammonium sulphate was to be reduced to the level of the selling price of nitrogen, and the Federation was determined to buy acid much more cheaply than at present. No effort was being spared to reduce the cost of production and administration, because, as the output of ammonium sulphate grew, the Chilean nitrate producers would attempt to reduce costs by improving the yield. Their present cost was, roughly, £8 10s. per ton, inclusive of the royalty of £2 10s. paid to the Chilean Government. On May 31 the productive capacity of the firms in the Federation represented over 90 per cent. of the British output, and it was significant that Synthetic Ammonia and Nitrates, Ltd., whose large plant at Bellingham would probably begin to produce within six months or so, had decided to become a member. The use of ammonium sulphate was extending in France, where 25,400 tons of nitrogen as ammonium sulphate was consumed in 1921 (19,400 t. in 1913), compared with 23,600 t. of nitrogen as nitrate of soda (48,700 t. in 1913), and the demand had grown even more in this country. Germany was consuming about 320,000 t. of nitrogen annually, *i.e.*, about 10.3 lb. per acre, as against 2.0 lb. in France and 4.5 lb. in England, and the total consumption of nitrogen in the three countries was 404,300 t. per annum. The prospects of the industry could be judged from the consideration that if these three countries were to consume 12 lb. of nitrogen per acre of arable land the total annual consumption would be 755,500 tons.

STANDARD CHEMICAL CO., LTD., CANADA

The eleventh annual statement, for the year ending March 31, 1921, of this company reflects the extreme depression that has existed in the Canadian chemical industries engaged in the production of acetate of lime, methyl alcohol, etc. from wood. The company has plants at Sault Ste. Marie, Longford, Donald, Parry Sound, South River, Thornbury in Ontario, and Montreal, Fassett, Cookshire, Mont Tremblay, Weedon in Quebec, and the total carbonising capacity is approximately 135,000 cords per annum. During the last financial year, 59,278 cords was retorted, or 44 per cent. of the capacity, which is a decline of 22 per cent. from the total carbonising capacity is approximately compared with \$340,327 in 1919-20, and the net loss was \$762,368, as against \$166,967. The actual deficit shown in the accounts is \$624,088. Current assets are estimated at \$1,411,659 (1921, \$1,942,065); liabilities, \$681,185 (\$606,223); and stocks, \$1,121,622 (\$1,616,814). Total assets are \$6,733,670, against \$6,880,485 last year. The demand for the company's products has increased since the close of the financial year and the company's plants are now working at 60 per cent. capacity.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for November 9 and 16)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina ..	Pottery	561
Australia ..	Fine and heavy chemicals ..	494
" ..	China, glassware, crockery ..	"
Canada ..	Dry zinc white, lithopone, white lead, umber, slenna ..	496
" ..	Drugs	497
" ..	Perfumes	521
" ..	Fire-extinguishing materials ..	†
Egypt ..	Drugs (tender for)	9400/F.E./C.P.
Egypt, Sudan, Palestine ..	Earthenware, semi-porcelain ..	509
Italy ..	Groundnuts, oilseeds, Chilean nitrate	503
Netherlands ..	Earthenware	504
Russia and Baltic States ..	Fertilisers, paint, colour, oils ..	508
Spalo ..	Fine and pharmaceutical chemicals, heavy chemicals for bleaching, dyeing, etc. ..	538
" ..	Electrical porcelain	539
" ..	Dyes, colours, drugs	541
Switzerland ..	Chemicals, drugs	547
United States ..	"Stainless" steel and iron ..	511
" ..	Fuller's earth, caustic soda ..	512

* Ref. No. 412/7/1/1/10A. Official Secretary, Commercial Bureau, Australia House, Strand, London, W.C. 2.

† Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

TARIFF CUSTOMS EXCISE

Belgium.—A Bill to revise the customs tariff is to be presented to Parliament during November.

Germany.—A list of the monopoly taxes on imported spirits is given in the issue for November 16. The duty on imported acetic acid and vinegar has been increased to 135,555 marks per hectolitre of anhydrous acid.

Hungary.—A commercial agreement based on the principle of "the most favoured nation" has been made with Esthonia. Goods recently added to the list of free imports include dógras, coal tar, certain coal-tar oils, oil colours, opium, chemical paper (not photographic), minerals, materials for grinding, cleaning and polishing, firebricks, earthenware, metal sheets, bars and wire.

Italy.—By a recent decree, the duties on synthetic organic dyestuffs and intermediates are increased; the restrictions on the import of these chemicals is withdrawn; and mineral oil-fuel is admitted duty free. Export licences are no longer required for aluminium scrap, calcium cyanamide, ammonium nitrate, and pyrites.

Kenya.—Under the new customs tariff specific duties are levied on imports of butter substitutes, edible fats, cement, kinematograph films, matches, metal wire, methylated spirit, mineral oils, salt, soap, spirits, and sugar. *Ad valorem* duties of 30 per cent. are applied to proprietary medicines, essential and perfumed oils, and of 10 per cent. to asbestos packing, glass and earthenware bottles and

jars, tinplate, carbon dioxide, certain metals, fire-clay, various oils, colours, varnish, driers, and paper. The duty-free list includes preparations for treating latex, explosives, fuel, creosote, drugs, medicines, disinfectants, rectified spirit for pharmaceutical use, fertilisers and manures, salt, fungicides, insecticides, radium, and vaccines.

Mexico.—The importation of opium, cocaine, morphine, etc. is prohibited save by permission of the Health Department.

Palestine.—From November 1 excise duties are leviable on imported alcoholic liquors, in addition to the customs duties.

Poland.—A commercial convention with Austria has been signed.

Spain.—The full text of the commercial treaty with the United Kingdom is reprinted in the issue for November 9.

TRADE NOTES

BRITISH

Gambia in 1920 and 1921

The chief agricultural product of Gambia is the groundnut crop, and while this continues to be profitable other crops are unlikely to attain importance. The climate is unsuitable for cotton-growing, the production of palm kernels is diminishing, and the export of wild rubber has now ceased. Owing to the prime importance of agriculture to the Colony, the establishment of a Department of Agriculture is being considered. Rhum palms, mahogany and rosewood are utilised locally, but the quantity and quality are insufficient to warrant exportation. The year 1921 was a very bad one for the Colony, and the total foreign trade declined by £3,500,000 to £1,678,021; the export of groundnuts was 59,175 tons and of palm kernels 302 t., as compared with 85,190 t. and 468 t., respectively, in 1920.—(*Col. Rep.-Ann.*, Nos. 1020, 1121, 1922.)

FOREIGN

Japanese Imports of Paraffin Wax and Stearin

The paraffin wax imported into Japan comes mainly from Burma and Sumatra, 28 per cent. being derived from the United States. Australia is the chief source of supply of stearin, the United States and Manchuria coming next with 30 and 10 per cent., respectively.

Year	Paraffin wax (m.p. under 45°C.)		Paraffin wax (m.p. over 45°C.)		Stearin	
	Long tons	1000 \$	Long tons	\$	Long tons	1000 \$
1913	3,715.5	383.6	4,340.3	518.9	324.2	67.2
1916	6,139.7	671.8	8,413.2	1,168.9	234.3	54.5
1918	4,324.4	950.5	10,949.1	2,434.5	110.0	42.0
1920	3,372.5	708.0	12,879.1	3,077.5	328.4	158.5
1921	3,800.9	555.6	11,601.3	2,798.5	120.8	43.5

Japanese Exports of Camphor, Menthol and Peppermint Oil

Exports of these commodities during the first six months of 1920, 1921, and 1922 were as follows:

	1920		January-June 1921		1922	
	lb.	\$	lb.	\$	lb.	\$
Camphor ..	974,522	..	423,625	..	1,962,670	..
Menthol ..	354,961	..	137,783	..	96,976	..
Peppermint oil ..	275,713	..	116,702	..	107,957	..

The percentage distribution of the exports of camphor during the first half of 1922 was as follows:—United States 57, Great Britain 14,

British India 10, France 9, and Australia 4. The value of the exports of menthol and peppermint oil during the same period of 1922 was 793,634 yen and 219,488 yen, respectively (yen=2s. 0½d. at par).—(*Oil, Paint and Drug Rep.*, Oct. 9, 1921.)

Trade Notes from Finland

The manufacture of mineral and other colours is to be undertaken at Nedertornea by a new company, the Kyläjoki Värehtdas O/Y (capital 100,000 Finnish marks). (Finnish mark=95d. at par, now about 1.25d.)

A new company, the O.Y. Star A.B. Tammerfors, has been formed with a capital of 2 million Finnish marks, and has taken over the drug factory of the Tammerfors Droghandels A.B. with a view to increasing greatly its operations.

During the first half of 1922 the export of matches from Finland was 1209 metric tons, valued at 18'03 mill. Finnish mk., as compared with 742 t., valued at 6'90 mill. Finnish mk., in the same period of 1921.—(*Chem. Ind.*, Sept. 18, 1922.)

Swiss Chemical Trade

The following official figures afford a comparison of the import and export trade of Switzerland in certain chemical products during the first four months of 1913, 1921, and 1922:—

Imports:—	1913	January—April 1921	1922
		Metric tons	
Turpentine oil	6.85	4.57	5.10
Caustic soda and potash ..	35.72	9.82	25.39
Chloride of lime	5.44	2.83	1.30
Tar-oil derivatives, etc. ..	6.21	24.04	4.63
Coal-tar intermediates ..	12.27	13.09	3.53
Benzine, benzol	58.68	110.09	153.69
Aniline	4.70	0.58	3.90
Aniline compounds	3.84	0.98	1.01
Benzyl chloride, nitrobenzene, etc.	4.79	1.72	1.20
Logwood extract	2.37	1.02	0.69
Coal-tar dyes	2.72	1.57	1.64
Linseed oil	19.72	10.01	17.46
Petroleum	254.75	56.82	70.23
Exports:—			
Soda ash	—	1.56	14.83
Coal-tar dyes	20.90	15.14	16.88
Indigo	7.75	0.45	11.68

Manchurian Trade in Dyes and Paints

During 1920 supplies of dyes in Manchuria were insufficient and prices high, but in 1921 the small demand and the reappearance of German dyes caused a fall in prices which enabled synthetic indigotin again to compete with natural indigo. Numerous brands of German and American dyes are sold in Manchuria, the latter being reputed of first-class quality and selling readily. Imports from Germany were double those of the previous year and many of the well-known German makes reappeared on the market, mostly in limited quantities. All coal-tar dyes are packed in 8 oz. and 20 oz. tins. In the paint market Japanese lead paints have almost a monopoly, but two brands of British red lead are still in fair demand. Only limited quantities of paint and varnish are imported from the United States. Statistics of the imports of dyes and paints during recent years are given below:—

	1913	1920	1921
Natural indigo, paste ..	4,257,500	2,118,930	1,369,000
Synthetic indigotin, paste	45,900	2,003,200	273,333
		Halkwan taels*	
Coal-tar dyes	288,270	176,348	371,550
Dyes, other	60,302	94,106	53,382
Paint, paint oil	116,135	275,609	248,000

* The average value of the Halkwan tael was 36.5d. in 1913, 78.8d. in 1920, and 41.8d. in 1921.

—(*U.S. Com. Rep.*, Oct. 9, 1922.)

REVIEWS

RESEARCHES ON CELLULOSE, 1910—1921. By C. F. CROSS and C. DORÉE. Vol. IV. of the "Cross and Bevan Series." Pp. 253. London: Longmans, Green and Co., 1922. Price 15s. net.

It is gratifying that Mr. Cross has been enabled, with the help of Dr. Dorée, to issue a fourth part of the collected "Researches on Cellulose," the preparation of which was originally undertaken in collaboration with the late Mr. E. J. Bevan. The series dates back to 1895, and the present volume is of special importance as it deals with a period marked by unusual activity in the scientific study of cellulose.

The authors have naturally been confronted with the difficulty of classifying under appropriate headings the researches they have selected for mention. This has been successfully overcome, one section being devoted to the physical properties and relationships of the cellulose complex, and another to the progress made in recent attempts to elucidate the constitution of the molecular unit of celluloses. Thereafter, the physical and chemical problems of modified celluloses are discussed and, in conclusion, a review is given of modern industrial developments.

Following the method adopted in earlier volumes, the authors provide useful summaries of selected researches and, from time to time, add critical notes which the reviewer, although holding somewhat different opinions, has read with genuine appreciation. The question raised in the introduction as to whether a volume of this nature is justified can at once be answered in the affirmative. Not only is it an immense benefit to the student of polysaccharides to have the unwieldy mass of publications on cellulose weeded out on his behalf, but the discussions on the papers themselves will be of service in preventing narrow views being taken by the specialist. The present book will do more than its predecessors to bring together the two different schools of research workers on cellulose. We have one type of inquirer, represented by Mr. Cross and his collaborators, who regards the complex as an organised colloidal structure and finds no help in the molecular constitutional views of the organic chemist. On the other side there is the constitutional chemist inclined to think exclusively in terms of groups and molecules. These schools have to be brought together, and the amalgamation cannot be effected by fair words and compliments.

Mr. Cross who, on his own confession, is an agnostic when it comes to questions of a molecular constitution for cellulose, has the courage of his convictions. There is much to be said for his policy of tilting (with all courtesy) at the academic chemist, or rather at chemists who adopt the lofty attitude implied in the statement that "cellulose is nothing more than a polymerised dextrose-glucoside of dextrose." Such statements seriously damage the position of the scholarly investigator who recognises that a structural formula for the molecular unit of cellulose is but one step in a long journey. To take a simple parallel, he is unlikely to forget that, although the composition of silica is known and the compound has been synthesised, the mechanism of building up the organised structure of a diatom is beyond the chemist's power.

With Dr. Dorée, Mr. Cross adheres to the view that the divergence which starch and cellulose show

"from each other and from the anhydro-hexoses is not to be displayed in terms of polymerisation." The theoretical chemist, interested in the celluloses chiefly as aggregates of organic molecules, might reasonably refute some of the arguments used in the present volume and point out that current ideas regarding the constitution of the simple sugars are insufficiently expressed, but a discussion of this nature falls outside the scope of a review.

What has been said will show that the book is more than a reference volume. It is designed for the thinker, and will be appreciated by a wider circle of readers than the earlier issues. Disappointment may be felt in the brevity of the reference to the decomposition of cellulose by bacteria and the possible development of such processes to the production of power alcohol. Otherwise, the subject-matter is well-proportioned, and a fair balance has been maintained between different aspects of studies on cellulose. Special emphasis is laid on volume relationships, and the phenomena of fluorescence, as studied by S. J. Lewis, is accorded a prominent place. Papers published in the less accessible journals are well abstracted, and the essential features of the originals are reproduced with commendable accuracy.

J. C. IRVINE.

- (1) COLOUR INDEX. PART I. Edited by Dr. F. M. ROWE. Pp. 24. Bradford: The Society of Dyers and Colourists, 1922. Subscription price of the whole work, in monthly parts, 84s.
- (2) THE MANUFACTURE OF DYES. By J. C. CAIN. Pp. 274. London: Macmillan and Co., Ltd., 1922. Price 12s. 6d. net.

(1) The spirit of enterprise, which was stimulated by the war, pervades industrial chemistry throughout the British Empire, and its manifestation in the projection of a comprehensive Colour Index, of which Part I has just been issued, does credit to the Society of Dyers and Colourists, under whose auspices the work is being undertaken. The special committee of that Society, headed by Mr. Ernest Hickson and supported by very eminent experts, has enabled the editor, Dr. F. M. Rowe, to present an index which in form and arrangement compares favourably with similar publications.

Part I contains the names, constitution and literature references for over 100 dyestuffs, beginning with the nitroso-compounds. The names are so arranged that the firms who produce the colours can be given in alphabetical order, and references to the literature are arranged chronologically. It was obviously impossible to give all the commercial names of the dyes mentioned, because the manufacturing firms frequently change them for various reasons; therefore, it was an excellent idea to reserve a large portion of the Index for notes which the worker in this field is bound to make for himself. The dyes given in Part I are well known to the expert, and it will be interesting to see, as the work progresses, how the committee has solved the problem of the more obscure dyes, such as Benzo Fast Colours which are, without any exception, wrongly described in the text-books.

Although the Index is, speaking generally, very accurate, there are a few errors and omissions to be noted. Erio Azurine has not the constitution amidodimethylanilinedioxy-S-acid, but it is the dye mono-ethylamidoaniline chromotropic acid

(Friedländer VII, p. 363, A.D.R.P. 8759, June, 1904, Richard), No. 59. Certain brands of the dye called Chrome Printing Yellow G. etc., No. 36, are, it is true, made with salicylic acid, but for wool-dyeing the combination m-nitraniline-o-cresotinic acid is much to be preferred, because it is at least 30 per cent. stronger. The treatment of different brands of Meta-Chrome Browns is, in the reviewer's opinion, somewhat inadequate; and many of the Meta-Chrome colours are not combinations with m-diamines; F-acid and others are also used, and the most important is the combination pteramic acid-chloro-m-diamine.

It would be very unfair to expect absolute accuracy, because this is technically impossible, and it is well known that "Schultz" also makes a number of mistakes which are practically unavoidable. There are, however, two omissions of great importance. First "Friedländer" must be noted, because unless the class is given, it is impossible to find the German patents; and every dyeworks' chemist has "Friedländer" at hand. If the committee cannot give references to "Friedländer," it must at once prepare a complete collection of all the dyestuff patents.

The second point relates to absorption-spectra. The small errors mentioned above would not have been made if the absorption-spectra (after Formance) had been consulted. As only Part I of the work has been issued, one cannot know if the committee intends to insert these missing data, but future parts will be awaited with great interest, not only for their intrinsic value but because they will doubtless bear witness to the great progress which the British dyestuffs industry is making.

(2) It was with a deep sense of loss that this book was opened, as Dr. Cain was very well known to the writer, who was aware of his intention to write a text-book on artificial dyestuffs. An unhappy fate appears to hover around the writers of large text-books on this beautiful subject, and the "torso" left by Cain in his desk shows that he was assembling the necessary material for a work which would probably have become a standard one. His ingenuity in seeking out all the accessible data recalls the memory of Dr. K. Heumann, who also died before his big work was finished.

The arrangement chosen by Dr. Cain does not differ from that of other authors, but it was his intention to give not only the constitution of the dyes but also extracts from the patents and other hints on manufacture. There is no doubt that even the short outlines which the author has left, show that he was a master of his subject, and we must be grateful to Prof. J. F. Thorpe for having published the manuscript, as he states, "practically as he received it."

H. E. FIERZ.

GRUNDLEGENDE OPERATIONEN DER FARBENCHEMIE.
By H. E. FIERZ-DAVID. Second edition,
revised. Pp. xii+266. Berlin: Julius Springer,
1922. Price, bound, 12s.

The second edition of this valuable work differs but slightly from the first edition, which was reviewed in these columns in 1919 (p. 486 R), but certain additions have been made which increase its utility. Thus two methods are given for preparing H-acid as well as for gamma- and J-acids. The amino-anthraquinones are described and the mode

of preparing anisoles from the corresponding chloro-derivatives explained. Other changes effected relate only to minor details, but paper and binding have been brought up to peace-standard.

THE PROPERTIES OF ELECTRICALLY CONDUCTING SYSTEMS. By PROF. C. A. KRAUS. *American Chemical Society, Monograph Series.* Pp. 415. New York: The Chemical Catalog Co., Inc., 1922. Price \$4.50.

Probably more experimental work has been carried out in the field of electrically conducting systems in recent years than in any other, and the literature on the subject has grown so large and is so scattered that it has become practically impossible for anyone who has not actively pursued the subject for some years to obtain a comprehensive view of it. Prof. Kraus has confined himself mainly to pure conductance phenomena and has dealt only briefly with other properties of electrolytes and with the more general problem of electrolytic dissociation. Within the restricted field he has chosen, the author has produced a work of the greatest value. He writes, naturally enough, from the standpoint of the American school of electrochemists, and in his brief treatment of the general theory he perhaps dismisses too lightly those recent theories which attempt to find a solution of the anomalous behaviour of strong electrolytes in the electrostatic attraction between the ions. Whatever may be the shortcomings of the theories of this kind which have been proposed up to the present, these forces do exist and must be taken into account before we can obtain a really comprehensive theory of electrolytes. A very valuable feature of the book is the great prominence given to non-aqueous systems; in fact, they are treated much more fully than are aqueous solutions. Unfortunately there has always been a tendency to neglect non-aqueous systems and to build up theories entirely on results derived from the study of aqueous solutions. The work under review brings the whole subject well into perspective.

The greater part of the book deals, naturally, with electrolytic solutions and the whole subject is treated very fully and in great detail from the standpoint of conductance phenomena. In a work of this kind, covering such a wide field, very careful selection of the available material is imperative, otherwise a false or one-sided impression may be conveyed to the reader. The author has done this very successfully and it would be difficult to find fault with his choice of material. In the same way no complete bibliography is given, but the selection of the more important references provided is sufficient to enable the reader to explore the whole field.

In addition to the main subject of electrolytes, there are three chapters dealing, respectively, with fused salts and solid electrolytes; the properties of metallic conductors; and systems intermediate between electrolytic and metallic conductors, the last being an account of Prof. Kraus's recent important work on solutions of metallic sodium in liquid ammonia. These three chapters, which are of the greatest interest, contain some very striking results which must inevitably lead sooner or later to a clearer understanding of the nature of the structure of metals and solid salts.

Throughout the text great use is made of the application of graphical methods in the interpreta-

tion of experimental results. The whole book is very clearly written and the examples and illustrative diagrams are numerous and well chosen. The book makes most interesting and easy reading and Prof. Kraus has rendered a very great service to chemists in writing it.

C. S. SALMON.

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HANDBOOK OF CHEMICAL ENGINEERING. Edited by D. M. LIDDELL and prepared by a staff of specialists. Vol. I. Pp. 517. Vol. II. Pp. 519-1008. New York and London: McGraw-Hill Book Co., Inc., 1922. Price 40s.

SYNTHETIC COLOURING MATTERS. DYESTUFFS DERIVED FROM PYRIDINE, QUINOLINE, ACRIDINE, AND XANTHENE. By PROF. J. T. HEWITT. *Monographs on Industrial Chemistry*, edited by Sir E. Thorpe. Pp. 405. London: Longmans, Green and Co., 1922. Price 14s.

THE ANALYSIS OF RUBBER. By J. B. TUTTLE. *American Chemical Society, Monograph Series.* Pp. 155. New York: The Chemical Catalog Co., Inc., 1922. Price \$2.50.

MODERN GASWORKS CHEMISTRY. By DR. G. WEYMAN. Pp. 184. London: Benn Brothers, Ltd., 1922. Price 25s.

GESAMMELTE ABHANDLUNGEN. By PROF. F. KEHRMANN. Vol. I. Part I. *Untersuchungen über Komplexe Anorganische Säuren.* Part II. *Untersuchungen über Sterische Hinderung.* Pp. 203. Leipzig: Georg Thieme, 1922. Price, paper, 8s.

WARENKUNDE. By DR. K. HASSACK. Vol. II. *Organische Waren.* Fourth edition, enlarged. Pp. 150. Berlin and Leipzig: Vereinigung Wissenschaftlicher Verleger, 1922. Price 1s. 6d.

NINTH ANNUAL REPORT OF THE MELLON INSTITUTE OF INDUSTRIAL RESEARCH, UNIVERSITY OF PITTSBURGH. By E. R. WEIDLEIN. Pp. 23. The Institute, Pittsburg, Pa., 1922.

RECENT PROGRESS IN SMOKE ABATEMENT AND FUEL TECHNOLOGY IN ENGLAND. By R. J. MCKAY. *Smoke Investigation. Bulletin No. 10.* Pp. 62. Mellon Institute of Industrial Research, Pittsburg, Pa., 1922.

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VANILLE, VANILLINE, VANILLE-EXTRACTEN. By DR. W. L. UTERMARCK. *Koloniaal Instituut te Amsterdam. Mededeeling Na. XVII. Afdeling Handelsmuseum No. 3.* Amsterdam: Koloniaal Instituut, 1922. Price 2.50 florins.

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CHEMICALS AND ALLIED PRODUCTS IN 1919 AND 1920. Pp. 150.

COAL STATISTICS FOR THE YEARS 1919, 1920, 1921. Pp. 115.

REVIEW

Vol. XLI]

DECEMBER 15, 1922

[No. 23

WHAT CHEMICAL INDUSTRY OWES TO PASTEUR

LOUIS A. FERNBACH

For the Centenary of Pasteur's Birth, December 27, 1922

OF the most eminent scientists who are universally held to be benefactors of mankind, no one bears a more honoured name than Louis Pasteur. Public health has derived such immense benefit from his work, and ideas concerning contagious diseases and their prevention have become so diffused among the greater mass of the public, that the medical side of Pasteur's discoveries, and the revolution which they promoted in medicine and surgery, are appreciated almost universally.

But even among educated people who have a fairly good knowledge of Pasteur's life and discoveries, very few realise that this immense progress was the natural outcome of Pasteur's earliest researches, and that, before becoming an eminent master in pathology, he acquired fame by his biochemical work and its numerous applications in the fermentation industries.

This great chapter of Pasteur's scientific life well deserves a short re-statement in this *Journal*, exclusively devoted to chemical industry, especially in view of the celebration of the centenary of his birth.

One of the most curious features of Pasteur's earliest work is that he first investigated a question which is apparently very remote from the subjects of his subsequent researches. Under the guidance of his great master, the famous physicist Biot, he undertook a study in crystallography—namely, the crystalline forms of the various tartaric acids and their salts; and he was thus led to the discovery of facets which had escaped the notice of previous illustrious workers, the so-called hemihedric facets, a discovery which was the origin of the famous theory of molecular asymmetry. In a series of papers, Pasteur demonstrated the close relationship subsisting, on the one hand, between crystalline form and rotatory power, and, on the other, between molecular structure and the action on polarised light, a subject which has since been greatly developed and which forms one of the foundations of modern organic chemistry.

The study of tartaric acid led to the conclusion that it and many other optically active sub-

stances exist in four different forms:—(a) two optically active forms, having equal but opposite rotatory powers, the asymmetric crystals of each being the mirror-image of the other; (b) an equimolecular mixture of the above forms which is optically inactive *by compensation*, and known as the *racemic* form; (c) a form which is inactive *by nature*, its inactivity being due to its crystalline as well as to its molecular symmetry. Unlike the racemic form, this last form cannot be resolved into active compounds; and this fact leads us to the next period of Pasteur's discoveries—namely, his studies on fermentation.

Among the various methods employed by Pasteur to resolve the racemic form of tartaric acid into its two active constituents, the most striking is certainly the biochemical method, because it represents a most important link in the harmonious sequence of his researches. Having found that a solution of ammonium tartrate ferments easily (through bacterial infection, as we are now able to say), Pasteur transferred some seed from a fermenting solution into a solution of ammonium paratartrate (the racemic form), which fermented equally well; but the polarimetric observations, made in order to control the progress of fermentation, revealed an unexpected and most important fact—namely, that the dextrorotatory form disappears, and that the final residue of fermentation is the levorotatory ammonium tartrate. The same effect was obtained with a fungus, which proved later to be *Penicillium glaucum*.

These experiments are of capital importance. Not only do they provide the first instance of the resolution of a racemic body into its active constituents by a biochemical method that has since been applied in many directions, but they also afford evidence of the sensitiveness of micro-organisms to the optical properties and molecular arrangement of organic compounds, of which the processes of *selective fermentation* have since furnished numerous examples. These experiments first brought our great master into contact with micro-organisms, and thus laid

the origin of a new science whose importance cannot be overestimated.

The attention which Pasteur was thus led to pay to a particular form of life was considerably favoured by the fact that, at this early period of his career (he was then 32), he was called to act as Dean of the Faculty of Sciences in Lille, in the centre of one of the chief industrial districts of France, where the fermentation industries, especially the manufacture of alcohol and beer, are widespread, and at that time were conducted on purely empirical lines.

In this new field of investigation, Pasteur had to organise the fight against a stubborn prejudice, emanating from one of the greatest chemists of that time, Liebig, who for many years refused to admit the specific action of micro-organisms, holding the opinion that they were merely organic matter in a state of decomposition, which state was communicated to the compounds undergoing fermentation.

One of the most striking instances which appeared to support Liebig's views was lactic fermentation, and the transformation which it promotes of the sugar into lactic acid. To start such a fermentation, it is only necessary to add a small quantity of spoiled meat or old cheese to a solution of sugar, in presence of chalk. Pasteur demonstrated that above the deposit of chalk, which formed at the bottom of the flask, there appeared a thin grayish layer, which consisted of minute rods, and that some of these rods, when introduced into a fresh solution, promoted a new lactic fermentation. The lactic ferment, far from being in a state of decomposition, as claimed by Liebig, multiplied itself vigorously in the course of the fermentation. The existence of numerous varieties of the lactic bacillus was established by the experiments of Lord Lister, whose work on this subject corroborated the results of his great friend, Louis Pasteur.

The part played by yeast in alcoholic fermentation held Pasteur's attention for many years. Through his experiments we have learnt that yeast reproduces during the splitting-up of the sugar molecule, thus confirming the view expressed many years before by Cagniard-Latour, that yeast promotes fermentation by its vital activity. In addition to contributing to our knowledge of the influence of various factors on the development of the yeast cell and on its action as an alcoholic ferment, on its origin and diffusion in nature, on the production of new compounds, *e.g.*, glycerin and succinic acid, on the part played by oxygen in the maturation of wines, on the oxidising functions of the acetic ferments (a subject much developed subsequently by Adrian Brown), Pasteur's researches on alcoholic fermentation have had a most profound influence on industrial practice; above all, they have taught us the importance of pure fermentation, which is one of the fundamental conditions of success in all industrial fermentation processes.

The necessity for securing pure fermentations appeared clearly to Pasteur as a consequence of observations made in his researches on wine and beer, namely, that the alterations which these beverages frequently undergo are due to the presence and development of minute organisms, the so-called disease ferments (*ferments de maladie*). The action of heat, which has since been applied industrially under the name of "pasteurisation," is an effective protection against disease; but a much more rational practice is to obtain a product under conditions which will secure stability. One of the most important of these conditions is *pure fermentation*, a term which signifies that the fermentation is promoted by an organism belonging to a definite single strain, in a liquid which has been previously deprived of all its living germs and which remains protected against all extraneous organisms.

The application of this fundamental principle has been of the greatest service in all fermentation industries. It involves working under conditions of absolute cleanliness, and all thinking wine-producers, brewers, distillers, vinegar manufacturers etc., now realise that the word *cleanliness* means *aseptic conditions of work*, which are the only safeguard against subsequent trouble. It involves also the use of pure cultures, which may be easily obtained by the methods worked out by Pasteur and which have been changed but little since.

However widely Pasteur's marvellous methods and discoveries have been applied, their possibilities are far from being exhausted, and an immense field lies open for their application to new fermentation industries that will benefit mankind.

École de Brasserie,

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FEDERAL COUNCIL FOR PURE AND APPLIED CHEMISTRY

For many months before his death Lord Moulton was occupied with the elaboration of a scheme for ensuring the closer co-operation of the various interests—academic and technical, pure and applied—which are embraced by our numerous chemical organisations. Lord Moulton was convinced that a serious defect in the organisation of public affairs in our country lies in the lack of solidarity of sentiment and of expression amongst chemists as a body. The culminating task of his life consisted in unifying the scattered chemical talent of the country, and teaching it to work for the common cause in unison with the engineer and the manufacturer; as Director of the Department of Explosives Supplies he accomplished this task, but none realised better than he that the extravagant cost of the achievement was largely traceable to the absence of previous organisation among chemists. His insight,

born of genius and sharpened by experience, told Lord Moulton that the conditions of peace are much like those of war: co-operation saves labour and treasure, and leads to that efficiency which is essential in a modern economic struggle. He saw the necessity of creating for chemistry a corporate organisation in which all branches of the science and practice should be embraced, which could put forward its collective view with the same force as had long been possible in other learned professions, such as engineering, medicine, and the law.

With this outlook Lord Moulton threw himself whole-heartedly into the scheme of the Federal Council for Pure and Applied Chemistry, and drafted an appeal for funds in order to rid British Chemistry of certain obvious disadvantages under which it now suffers. He believed that what is needed in this country is a central organisation for chemistry, which should bring under one roof our several important chemical societies, an exhaustive library, ample rooms for administrative purposes and for scientific meetings, and, if possible, the social amenities of a club. There was no thought of injuring the splendid traditions of the Chemical Society and the Society of Chemical Industry; both should retain their autonomy, but if these and other smaller allied societies are to meet modern requirements there must be that closer co-operation which only comes from physical proximity.

The provision of the needs just above mentioned calls for funds, and in the appeal which Lord Moulton drew up at the end of 1920 he estimated that £250,000 was required for premises, equipment, etc., and a further £250,000 for literary purposes. This appeal was agreed by the Federal Council and was signed by the Presidents of the sixteen societies then embraced by the Federal Council; it was being placed before prominent personalities in the chemical and manufacturing world for several months previous to the sudden death of Lord Moulton in March of last year.

We have lost our leader; we realise that we cannot hope, in the present condition of the world's financial affairs, to raise £250,000 for our project of placing chemistry in a position similar to that now enjoyed by engineering, medicine, and the law. Pending the better times which we all believe are in store for British industry and British enterprise, we can, however, do much to advance our project. We already have in existence a unifying body. The Federal Council for Chemistry was founded several years ago with a view to meeting two generally recognised needs: first, the promotion of co-operation and economy of effort between our several large chemical societies, and, secondly, the representation of those interests of chemical science and technology which are too general in character to be the sole province of either of our existing organisations. Following

the example set by the creation of our own Federal Council for Chemistry, many other countries have formed a national Council for Chemistry on very similar lines; all these national councils are now combined under the International Council for Chemistry which was inaugurated at the annual meeting of the Society of Chemical Industry in 1919 (J., 1919, 38, 208 T). The International Council now includes the national chemical councils of twenty-four States (J., 1922, 41, 328 R); it has held its three previous annual meetings in Brussels, Rome, and Lyons, and is to meet next year in Cambridge.

Hitherto, the International Union for Chemistry has been largely occupied with the organisation of its numerous international interests, such, for instance, as concern the production of international tables of fundamental constants of the elements and the introduction of a generally agreed system of chemical nomenclature; the "Tables annuelles de constantes et données numériques de chimie, de physique et de technologie," edited with such success by Dr. Charles Marie, are published under its auspices. Now that these and related matters of importance have been dealt with, and organisations created which will rapidly increase its productivity, it is intended to extend the scope of the Union and to include in its annual proceedings the presentation and discussion of reports on the progress and development of large scientific and technical questions. This branch of the Union's activities was indeed inaugurated at the recent meeting at Lyons, and the meeting at Cambridge next year will therefore be one of great interest and importance.

Our own Federal Council has taken an active part in the pioneer work of the International Union, although it should be stated that the bulk of the progress made has been due to the devotion of Professor Charles Moureu, its President for the last three years, and our other French colleagues. The Federal Council, in addition, has been able to do a good deal in securing joint action between our large organisations, such, for example, as promoting the arrangement for some measure of co-operation between the Chemical Society and the Society of Chemical Industry in the weekly publication of the *Journal* of the latter Society. A vast amount remains to be done in this direction, and especially in the establishment of a solid feeling that the chemist should have at heart the interests of his whole subject rather than that merely of the particular chemical society of which he is a member. The promotion of this feeling calls for the united effort of all chemists. It was with this purpose in view that the societies composing the Federal Council were asked to nominate to the Council men who would be active in initiating and carrying into operation measures for the strengthening of the whole chemical organisation of the country.

Hitherto, the principal expenses of the Federal Council have been the annual subscriptions to the International Union, and the revenue has consisted mainly of grants from the Chemical Society and the Society of Chemical Industry. These grants cannot be increased, because both societies have already large calls upon their limited resources for other indispensable purposes; yet money is required to enable the Federal Council to develop its work on an adequate scale. At the meetings of the International Council in Brussels, Rome, and Lyons the foreign organisations corresponding to our Federal Council entertained the delegates to the Union. We shall have to return the compliment at next year's meeting in Cambridge. Further, whilst the prevailing financial stringency makes it impossible to carry out the large scheme outlined by the late Lord Moulton, it is at least necessary that we should make a beginning. We therefore ask for contributions to be devoted towards the scheme, and so convert into a useful form the sympathy of our chemical colleagues with the objects of the Federal Council.

In the present article we have touched on many questions—and therefore, perhaps, in too scanty detail—and have left unmentioned many others which are also of vital importance to the chemical organism. The nudity of our chemical compendia, the paucity of our efforts to cultivate the social side of chemistry, and so develop the excellent work of the Chemical Industry Club—these and many other matters call for attention; they call for a few chemists to lead and for many to collaborate, and above all they call for financial support.

With the above considerations in view the Federal Council has appointed a Benefaction Committee, with the request that they will collect funds. The Committee now consists of Sir William Pope, Dr. E. F. Armstrong, Mr. H. E. Coley, Mr. E. V. Evans, Mr. Emile Mond, Mr. W. J. U. Woolcock, and Dr. S. Miall; other names may be added at a later date. It is intended to issue a preliminary list of subscriptions, and when this has been completed to make a widespread appeal in a more or less public manner. It is requested that contributions be sent to Dr. S. Miall, Society of Chemical Industry, Central House, Finsbury Square, London, E.C.

W. J. POPE.
E. F. ARMSTRONG.
H. E. COLEY.
E. V. EVANS.
EMILE MOND.
W. J. U. WOOLCOCK.
STEPHEN MIALL.

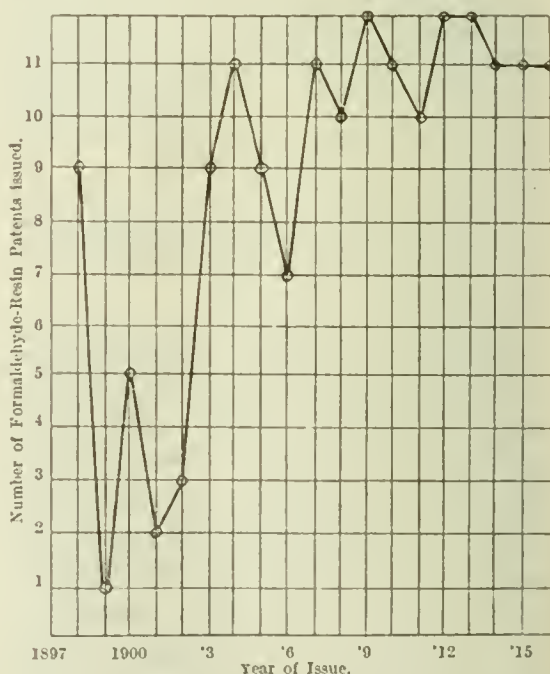
The First List of Contributors to the Fund will be found on page 534 of this issue.

RECENT RESEARCH ON FORM-ALDEHYDE-RESINS

ALAN A. DRUMMOND

SINCE 1872, when Baeyer first observed that phenol reacts with formaldehyde to give a resinous condensation product, much work has been done with a view to making synthetic resins of this type commercial materials, and as a result, primarily of research by Dr. Baekeland, the technical world has come to realise the possibilities of phenolic condensation products for use in many industries. The object of the earlier workers was merely to produce substitutes for shellac, and it was not until recently that the peculiar properties of these resins, notably their resistance to heat, electricity and chemical action, were appreciated fully. Varnish manufacturers are still actively investigating the possible applications of synthetic resins, but the lack of uniformity in behaviour of different batches, made under supposedly identical conditions, has so far precluded extensive use in this industry.

During the past thirty years many data, more or less empirical, concerning synthetic resins have accumulated, mainly in the patent files. The number of patents taken out year by year in Great Britain since about 1897 up to the beginning of the war, shows clearly that interest in synthetic resins has been increasing steadily.



The graph indicates a general upward tendency in the number of patents, reaching a maximum soon after the publication of Baekeland's lecture in America on Baekelite and its

applications (*J. Ind. Eng. Chem.*, 1909, 149). Research in this subject was, naturally, retarded by the war, but it is now receiving renewed attention. The later patents relating to the subject still convey an impression of empiricism, but this may be due to the nature of the record, because systematic scientific method can rarely be deduced from a survey of patent specifications. The fact remains, however, that little or no fundamental work is being published on the exact course of the reaction involved in the production of phenol-formaldehyde resins. It is, perhaps, more along the lines of physico-chemical investigation that new knowledge will come. Up to the present, work has been concentrated mainly on the investigation of the chemical properties of the condensation product, on its behaviour towards various reagents, and on efforts to identify the individual constituents of the resins. As a result of this chemical study, attempts have been made to ascribe a definite constitution to the colloidal resin, but the results have been conflicting. Baekeland deduced an anhydride formula from the results of elementary analysis, starting with an assumption based on work done by Lederer (*J. prakt. Chem.*, 1894, 158, 223), and Manasse (*Ber.*, 1894, 27, 2409), who was the first to claim the synthesis of oxybenzyl alcohol by the condensation of phenol and formaldehyde in presence of basic catalysts. Raschig (*Zeit. angew. Chem.*, 1912, 1939) disputed Baekeland's conclusions, but without advancing very clear proof of his own deductions.

Recent work by Coster van Voorhout (*Chem. Weekblad*, 1920, 17, 2) has supplied more definite information concerning the course of the reaction between phenol and formaldehyde. This worker has investigated the changes in viscosity that occur during condensation, and has successfully isolated chemical individuals from the reaction mixture. He has separated crystalline *o*- and *p*-oxybenzyl alcohols, when an alkaline catalyst was used, and he has shown the presence of dioxydiphenylmethane when the condensation was initiated by acids. His conclusion was that in all probability Baekelite consists of dioxydiphenylmethane (probably polymorphous) in colloidal solution, together with traces of phenol and formaldehyde.

It must appear from the foregoing that, valuable as a knowledge of the chemical constitution, based upon an investigation of the final condensation product, undoubtedly is, further practical advance can more readily be achieved by a synthetic study of the resin, *i.e.*, by investigating it before and during synthesis, rather than analytically after the synthesis has taken place. Such a study involves physical, as well as chemical examination: a study of the changes during condensation in such physical properties as viscosity and density. Coster van Voorhout's paper contains only a brief reference to viscosity

determinations; more data of this kind are wanted, and particularly by the manufacturer of formaldehyde-resins.

Air-drying varnishes or lacquers, containing formaldehyde-resins, are readily obtained; they yield films of good elasticity, which can be improved by the addition of such substances as celluloid, collodion, and cellulose acetate, but their durability in use is poor unless they have been stoved. A non-stoving varnish of acid-resisting properties would be of great service even in the chemical industry alone, particularly if it were also highly resistant to heat.

Another difficulty has been the restricted solubility of the finished resins; alcohol has proved to be the best solvent, even for the resins in their more soluble condition, *i.e.*, before the final reaction has been effected by stoving. Spirit as a solvent is not altogether desirable; for one reason, varnishes containing alcohol are liable to leave a track of trapped air-bubbles on the surface that is being covered, and these bubbles or pin-holes are not easily removed. Linseed oil, turpentine and similar oils are more useful varnish media. A process for obtaining oil-soluble synthetic resins has been protected (Albert and Berend, E.P. 15,875, 1914). Such so-called "albertole" resins apparently contain, in addition to the formaldehyde-resins, at least 50 per cent. of natural rosin, and although the process claims to effect a specific reaction between the synthetic and the natural resins so that a durable oil-soluble varnish is obtained, it is difficult not to suspect the durability of a varnish film of such composition. A claim for the production of oil-soluble resins has also been made, whereby advantage is taken of the different reactivities of *m*- and *p*-cresol with formaldehyde; *p*-cresol, with an excess of formaldehyde and an acid catalyst, is stated to give a resin soluble in oils (Robinson-Bindley, Weller, and Duleken, E.P. 134,563, 1918). The biggest field of application for synthetic resin varnishes, as now made, is as insulators in the electrical industry, where they are used as stoving varnishes, particularly for coating insulating fabrics and tapes, and for impregnating coils.

Following the amalgamation of three of the foremost American manufacturers of insulating materials under the ægis of the General Baekelite Company (*cf. J.*, 1922, 320 R), the pooled resources of scientific and technical information should make possible very distinct advances in the methods of manufacture and application of formaldehyde-resins. In view of this strong competition, British manufacturers of electrical insulating material who are beginning to realise the specially advantageous properties of these resins, are likely to be seriously handicapped in their efforts to establish sound commercial processes, unless their methods have a firm scientific basis, founded on the results of systematic research.

THE EXTRACTION OF GASOLINE FROM NATURAL GAS

GEORGE A. BURRELL*

Part I.—Extraction by Compression and by Absorption in Oil

The natural-gas gasoline industry was started about the year 1904 in the oldest fields of the United States, viz., those of northern Pennsylvania, and its development to the commercial stage followed as a consequence of the impossibility of meeting the demand for gasoline by any other means. In 1904 the automobile was still in its infancy, but a demand had already been created for gasoline, hitherto a by-product of little commercial value. Although some gasoline was extracted from natural gas in 1904, the industry did not assume commercial proportions until the year 1910. Table I gives statistics of production in the United States for the years 1916–1920. The total amount of gasoline of all kinds produced in the States in 1920 was about 4.5 billion gallons.

United States it is not known until the drill strikes the formation, whether an oil well or a gas well will be found, so close together do the pockets of natural gas and oil lie in the stratum. In such fields it is not uncommon to find both gas and oil in paying quantities in the same well. The term "paying quantities" must be used with reservation, because what would be a paying gas-well in the Eastern States, near extensive pipe-line systems and good markets, would not be a paying proposition in some parts of the West, where the natural gas cannot be conveyed to market except at prohibitive expense. It is different, however, with the oil, which can be stored, and of which a large quantity can be conveyed a long distance by a relatively small pipe-line; or it can be transported in tank cars.

"Wet" or "casing-head" gas is found in intimate contact with oil. It emerges from an oil well at the casing-head, finding its way thereto through the annular space in the well between the tubing and the casing.

TABLE I
Natural-Gas Gasoline Produced in the United States, 1916–1920

Year	No. of operators	No. of plants	Gasoline produced			Gas used	
			Gallons	Value \$	Average price per gall. cents	Volume 1000 cubic feet	Value \$
1916	460	596	103,492,680	14,331,148	13.8	208,705,023	14,600,300
1917	750	886	217,884,104	40,188,596	18.4	420,287,797	34,343,000
1918	503	1,004	282,535,550	50,363,555	17.8	419,108,661	40,419,700
1919	611	1,191	351,535,026	64,196,763	18.3	480,403,961	41,314,700
1920	576†	1,154	384,743,962	71,788,122	18.7	496,430,952	41,700,000

† Not comparable with other years because of new classification adopted.

(From statistics of U.S. Geological Survey.)

At the present time the production of gasoline from natural gas amounts to about 8 per cent. of the total production. This figure appears small, but it is important, because the addition of natural-gas gasoline to refinery gasoline increases the volatility of the latter, and so makes available much larger quantities of less volatile crude-oil distillates for conversion into gasoline. In no other way could the refiner at the present time meet satisfactorily the almost insatiable public demand for motor gasoline. It is probable that if natural-gas gasoline had not been forthcoming for increasing the volatility of motor fuel, the internal-combustion engine for automobiles would have been developed so as to burn less volatile oils, for it is certain that the problem of supplying satisfactory motor-cars would have been solved in some way or other.

OCCURRENCE OF GASOLINE IN NATURAL GAS

Natural gas invariably accompanies petroleum in oil-sand. At times the quantity is almost negligible, usually it is considerable, and frequently it is sufficiently great to turn a well into a "gusher." In the oil-sand the natural gas becomes saturated with the low-boiling constituents of the petroleum and these escape with it from the well.

Natural gas is divided into two great classes: "dry" or "lean," and "wet" or "casing-head" natural gas. By "dry" natural gas is meant gas from natural gas wells, not containing oil, at least not in commercial quantities. In some fields in the

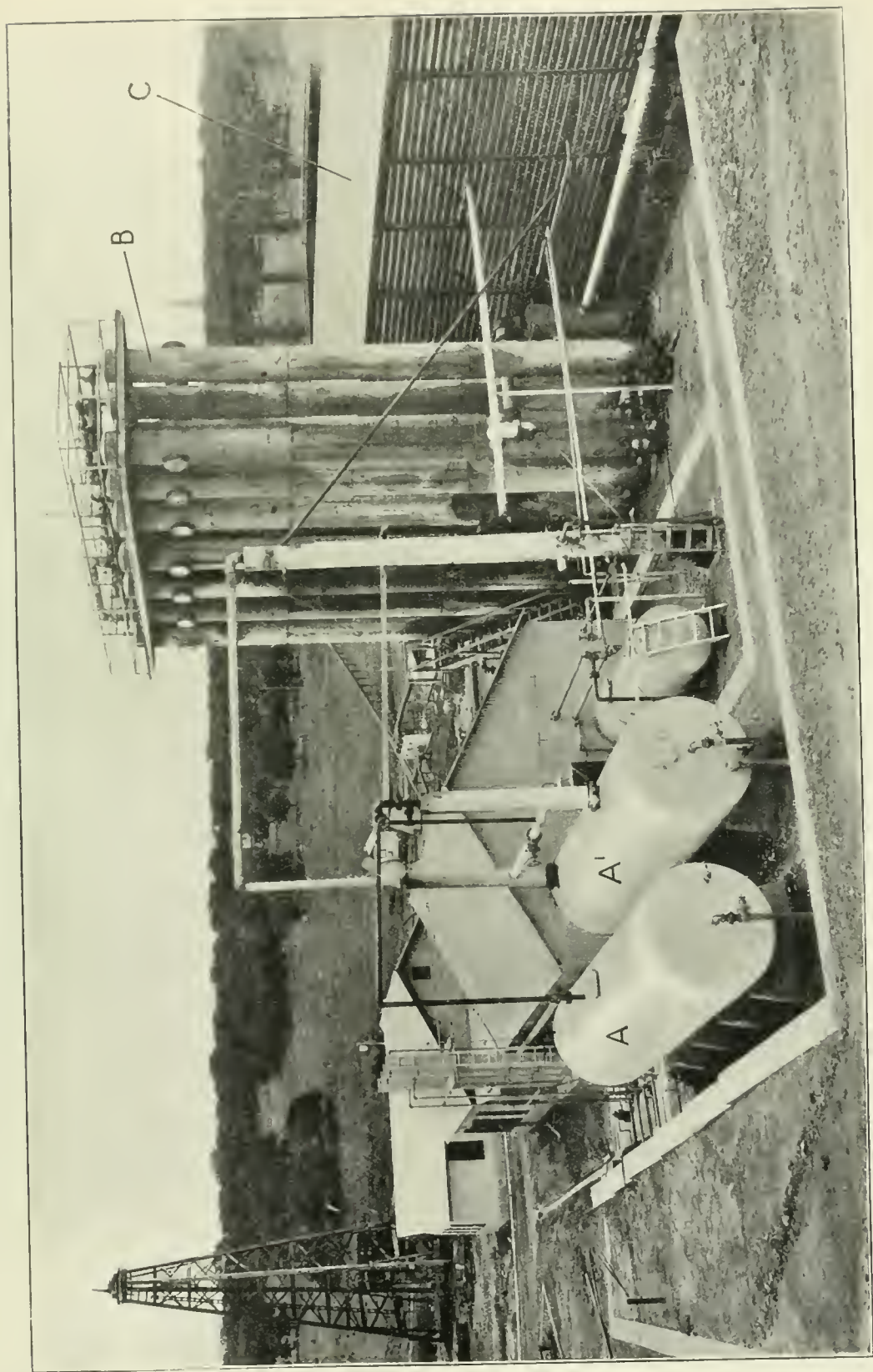
"Dry" natural gas seldom contains more than 0.5 galls. of gasoline per 1000 cu. ft.; "casing-head" gas contains up to 10–15 galls. per 1000 cu. ft. However, there is no sharp line of demarcation between the two kinds. "Casing-head" natural gas is but rarely found with a lower gasoline-content than "dry" natural gas.

It seems fairly probable that the hydrocarbons of "dry" natural gas were formed by processes analogous to those by which the oil was formed. In some cases, if not many, the natural gas found its way from the main body of the natural hydrocarbons, and lodged finally in the stratum where it was discovered. In its migration it freed itself from most of those hydrocarbons which are liquid at ordinary temperatures, retaining only a relatively small quantity of very volatile gasoline. "Wet" gas, however, being found in contact with crude oil of very high gasoline content, is naturally very rich in this constituent.

COMPOSITION OF NATURAL GAS

The composition of typical samples of "dry" and "wet" gas, as determined by the writer, is given below. The methane was drawn off with a Töpler pump at the temperature of liquid air, and the other hydrocarbons at gradually rising temperatures. Many fractionations were made to extract the several hydrocarbons in a sufficiently pure state. Statements in text-books to the effect that natural gas contains appreciable quantities of oxygen, carbon monoxide, hydrogen, and unsaturated hydrocarbons, have not been confirmed.

* Petroleum Engineer, New York.



Oil-absorption plant for extracting gasoline from natural gas.

Phillips Petroleum Co., Pershing, Oklahoma.

A, A'—steam stills; B—absorbers; C—cooling-coils under cover.

Analyses of Natural Gas

	A	B
	"Dry" gas	"Wet" gas
Methane	84.7	36.8
Ethane	9.4	32.6
Propane	3.0	21.1
Butanes	1.3*	5.8
Pentanes, hexanes, heptanes, etc.		3.7
Carbon dioxide	Trace	Trace
Nitrogen	1.6	†
Total	100.0	100.0

* Principally butanes

† Owing to unavoidable experimental error the nitrogen content does not appear; it is probably about 1.0 per cent.

EXTRACTION BY COMPRESSION

Gasoline was first extracted from natural gas by the compression method. The casing-head gas is subjected to pressures up to 300 lb. per sq. in., and cooled with water in pipe coils, while under pressure. The gasoline produced is condensed and trapped in storage tanks. To secure the maximum yield of gasoline from oil wells, the gas is frequently withdrawn at the casing-head of the well under a vacuum registering up to 25 in. of mercury. Under these conditions the well simply becomes a still, and owing to the reduced pressure, it happens, not infrequently, that after the natural gas from an old well has been exhausted, almost pure gasoline vapour distils off from the oil-sand. When some oil wells are connected up with many others to a common gasoline plant, they remain profitable sources of gasoline long after they have become almost valueless as oil producers. In methods of oil-winning only from 20 to perhaps 60 per cent. of the oil is recovered; hence the vast bulk of the oil remains underground. Although some gasoline compression plants are connected to as many as 1500 wells, the average number is from 100 to 300 wells. One of the largest compression plants in the United States, producing a maximum of 9000 galls. of gasoline per day, is connected to only 29 oil wells.

A natural-gasoline compression plant, in its usual form, is simplicity itself, and consists of a compressor or compressors, either belt-driven or directly connected to a gas engine; cooling coils arranged in headers made of 2-in. pipe, on which water drips; and receiving tanks, built to withstand the pressure, where the gasoline is condensed, and out of which it is automatically trapped into storage tanks. Other machinery comprises water pumps, supplying condensing water for cooling purposes; a gasoline pump to move the gasoline from tank to tank and to a loading-rack for shipment; a small generator to supply electric current for lights; and possibly a little machinery, such as a drill press or lathe, for minor repairs. There is usually also a vacuum pump connected to several 4- or 6-in. main gathering lines leading to various oil leases. Connected to these main gathering lines are 2-in. lines leading to the casing-heads of the oil wells from which the gas is withdrawn. Some gasoline compression plants are much more elaborate than the simple plant just described, because to many operators the industry has proved a very profitable one, and this fact is reflected in the size and efficiency of their units.

Pressures required to condense the gasoline from casing-head natural gas depend upon the gasoline content. When the desirable condensable constituents, principally pentane, hexane and heptane, are present in large amounts, pressures up to 100 lb. per sq. in. are sufficient, but usually pressures of 200 to 250 lb. are employed.

In compressing casing-head natural gas to pressures above 100 lb. per sq. in., two-stage compressors are used. In the first stage the gas is compressed to about 35 to 50 lb.; it is then cooled and given its final compression. For natural gas which gives up practically all its gasoline at pressures up to 100 lb., only single-stage compressors are employed. In two-stage compression but little condensate is collected in the first-stage cooling coils. This condensate is of low gravity, usually of sp. gr. between 0.7368 and 0.7000, and is mixed finally with the bulk of the condensate precipitated by the high-stage compressor. Two-stage compression is economical, because the temperature of compression is reduced, and more gas can be compressed in a given installation.

The output of a natural-gas gasoline plant is largely limited by the handling and transportation of the product, and by the extent to which it can be used. Enough pressure could be applied to condense far more of the paraffin hydrocarbons than are liquefied, but these lighter fractions, principally propane and butane, raise the vapour pressure of the entire mixture to such an extent that railroad regulations forbid its transportation; it becomes dangerous to handle, and loss by evaporation (weathering) becomes serious.

Some of these lighter constituents can be saved and fixed for safe transportation and efficient use by the addition of naphtha, of sp. gr. 0.7778—0.7609 and 450° F. (232.2° C.) end-point, to the hot compressed gases in the condensing coils. By this method any grade of gasoline can be made, and the vapour pressure of the mixture can be lowered sufficiently to make transportation safe and use efficient. This particular method of blending is called "hot blending." Many other expedients are adopted to serve the same purpose, but "hot blending" is the best.

In the Eastern States, where oil products of all kinds command a higher price than in the west, gasoline plants producing as little as 200 galls. per day are profitable under some conditions. It is rare in the eastern fields to find a compression plant producing more than 2000 galls. daily, whilst in the western fields of gaseous oil wells, plants to produce 5000 galls. daily are not uncommon.

A complete compression plant to handle about one million cu. ft. of casing-head natural gas per day, with gathering lines, vacuum pumps, booster stations, compressors, gas engines, buildings, water supply, tanks, loading racks, etc., costs about \$150,000. Production costs, including labour, overhead charges, depreciation, depletion, taxes, insurance, sales, supplies, repairs, etc., amount to from 7—13 cents per gall. Natural gasoline in the east now sells for about 18 cts. per gall. at the plant, and in the mid-Continent fields for about 15 cts. per gall.

ABSORPTION PLANTS

The oil-absorption method as applied to natural gas is essentially the same as that applied to shale gas by James Young of Clippens, England, in 1876. It was first applied to natural gas by the Standard Oil Co. of New Jersey in 1906, and a U.S. patent was issued to George M. Saybolt of that company in 1911. This patent has been the subject of litigation for about three years, but a decision is due shortly.

The oil-absorption method has a field of operation distinct from the compression method in that it

is applied to natural gas which contains a relatively small amount of gasoline vapour. The compression method is usually applied to casing-head gas containing more than 1 gall. of gasoline per 1000 cb. ft., and the absorption method to so-called "lean" or "dry" natural gas containing less than this quantity. However, the oil method is steadily usurping the field long held by the compression method, as operators are learning by experience that oil plants will work efficiently on rich natural gas and at low pressures.

The great bulk of the natural gas used industrially in the United States is the "dry" gas, which comes from gas wells and supplies light and fuel to cities like Pittsburgh, Pa., Cleveland, Ohio, Cincinnati, Ohio, Louisville, Ky., Tulsa, Okla., Fort Worth, Texas, and thousands of other towns and cities. The compression method cannot be used to extract the gasoline from this gas because the partial pressures of the desirable condensable constituents are so small that a prohibitive pressure would be required to precipitate the gasoline-content. The oil-absorption process is used instead, and by it the gas is brought into contact with an oil of sp. gr. 0.8333–0.8140, and having the following general characteristics:—

Characteristics of Absorbent Oil

Specific gravity	0.8284
Pensky-Martens closed-cup flash-point ..	250°F. (121.1°C.)
Cold test	28°F. (–2.2°C.)
Viscosity (Saybolt)	1,300

Distillation Test

Fractions	Per cent.	Deg. F.	Sp. gr.
1	10	537 (282.2°C.)	0.8159
2	10	543 (261.1°C.)	0.8178
3	10	551 (270.6°C.)	0.8192
4	10	557 (273.0°C.)	0.8202
5	10	565 (278.3°C.)	0.8211
6	10	565 (283.0°C.)	0.8221
7	10	585 (280.4°C.)	0.8245
8	10	595 (295°C.)	0.8269
9	10	618 (307.8°C.)	0.8309
10	8.5	660 (331.1°C.)	0.8373
	1.5	above 660 (331.1°C.)	

The oil containing the absorbed gasoline is pumped to a still in which the gasoline is distilled off, usually by means of live steam. The oil is then pumped back to the absorbers for another charge of gasoline, and so the process is continued, the oil acting simply as a carrier of gasoline from the absorbers to the still.

A complete unit consists of absorbers, weathering or vent tank, heat-exchangers, oil-cooling coils, still and condensers, pumps, boilers, piping, gas engine and compressors.

The absorbers vary in size and number according to the pressure and quantity of the gas and its gasoline-content. From the absorbers the oil passes to a weathering tank where the pressure is released, and gases that are loosely held are withdrawn to the compressor. The oil next passes to a heat-exchanger where it is heated by means of hot oil coming from the still, thereby reducing the fuel requirements of the plant. From the heat-exchangers the oil passes into the still where it meets live steam and where the gasoline is distilled from the oil. A mixture of steam, gasoline vapour and some absorbent oil pass out of the still, first into a so-called "knockout" box, where most of the water vapour and absorbent oil is precipitated under thermostatic control at temperatures of 170°–180° F. (76.7°–82.2° C.), and thence to the gasoline-cooling coils where the gasoline is condensed. The oil, freed of its gasoline, passes out

of the still through heat-exchangers into oil-cooling coils, where its temperature is further reduced by means of spraying water on the coils, and thence into the top of the absorbers for another charge of gasoline.

All sorts of apparatus to produce the above effects have been tried, such as horizontal and vertical absorbers, different kinds of filling material for the absorbers, such as wooden baffles, cobble stones, steel turnings, clay forms, etc., tubular and double-pipe heat-exchangers, open and closed types of steam stills, vertical stills, fire-heated stills, electrically and gas-engine operated pumps; and all this experimentation is resulting in standard types of apparatus of good design, to fit whatever conditions are encountered.

The type of plant just described is called an absorption plant, but, as a matter of fact, frequently more than half of the gasoline is produced by a compressor which is always included as part of the equipment. The absorbent oil extracts hydrocarbons from the natural gas which cannot be condensed in the gasoline-cooling coils of the steam-still. Therefore these vapours, along with other light vapours from the vent tank, are compressed up to pressures of 250 lb. per sq. in. and cooled in water-cooled coils while under these pressures. There results a deposit of gasoline lighter in weight and more volatile than the gasoline produced from the still, but which, when mixed with the latter, is transportable and usable. This combined product, known as "absorption gasoline," is more stable and of a lower gravity than ordinary compression gasoline. For this reason it is a preferred product and sells for one to two cents more per gallon. This is one reason why more and more casing-head gas is being treated each year by the absorption method than by the compression method. Another reason is that air enters the pipe-lines which draw natural gas from the wells under reduced pressure. The introduction of air decreases the capacity of the compressors, and, what is far more important, diminishes the partial pressure of the gasoline fractions in the gas so that higher and usually prohibitive pressures have to be employed to condense all the gasoline. The introduction of some air into pipe-lines leading to the absorbers of an absorption plant has but little effect on the efficiency of the plant. Rarely can the air-content of natural gas in compression installations be kept below 12 per cent.

It is also true that if the plant is efficient and if the operators have taken advantage of the best information available, all compression plants have small absorption plants to treat their residual gases, because these contain a certain amount of gasoline. No matter what pressure be used to precipitate it, the gasoline has an appreciable vapour pressure and inevitably finds its way into the outgoing gas; the amount will range up to 0.5 gall. per 1000 cb. ft. The best practice is to absorb this remaining gasoline in naphtha, in a tower, the naphtha remaining in contact with the gas long enough to raise its Beaumé gravity five or six degrees, after which it is diverted to a storage tank and a fresh supply added.

Thus we see that a compression plant is really a combination compression-and-absorption plant and an absorption plant is a combination absorption-and-compression plant. As the former combination is more selective in producing a gasoline free from

volatile constituents, it is coming into favour as an allround type of plant for treating both "wet" and "dry" natural gas.

The colder the absorbent coil, the better does it absorb gasoline; hence in oilfields where water is scarce, or hot in the summer time, artificial methods have been adopted to cool the oil. These methods usually take the form of some kind of refrigeration system, *e.g.*, ammonia coils. This plan has met with some success although such installations are very few.

In compression plants, expansion engines are used to a limited extent to cool the hot compressed gas from the compressors. In these engines, compressed gas is expanded from the power cylinder of an engine, and thus cooled it is passed through the outer tubes of double pipe coils, inside of which passes the gas to be cooled.

Most of the oil-absorption plants are installed on main lines of natural-gas companies supplying cities with gas for light and heat. Almost invariably the plants are located on the discharge side of compressor stations already installed for forcing natural gas to market. These compressor stations are adopted by the gas companies when the pressure of the gas from the wells has declined to a point that is insufficient to force the gas to market. This has occurred in all the natural-gas fields in the eastern part of the United States and in most of the western fields. The natural-gas industry is a declining one and already some gas companies have had to mix artificial gas with their natural gas to supply their customers. This is especially true in the winter time when consumption reaches its peak.

The pressure of the natural gas at these stations varies between 25 and 300 lb. per sq. in., and as a rule ranges from 100 to 200 lb. At higher pressures less oil is required for extraction than at lower pressures, for the same quality of gas. The quantity of oil is the principal determining factor in fixing the cost of an absorption plant, because the more oil that is required, the larger must be the absorbers, pumps, stills, boilers, lines, and other equipment. Therefore natural-gas companies have found in the gas delivered from their compressor stations, conditions almost ideal for the efficient working of the oil-absorption process. In addition, they had a water supply already at hand, a site, working force, shop equipment, houses, etc., all of which only had to be enlarged in building the absorption plants.

DEPLETION OF HEATING VALUE

Extensive tests have shown that the heating value of dry natural gas is lowered but little by extracting the gasoline. Only 1 to 5 pints of gasoline per million cb. ft. of gas are removed. This is equivalent to 10 to 20 cb. ft. of gas per thousand, and corresponds on the average to a decrease of 2 per cent. or less in the heating value. Ordinary dry natural gas has a calorific value of 900—1200 B.Th.U. per cb. ft., hence the slight decrease still leaves a gas far higher in heating value than artificial gas supplied to consumers. The depletion in volume due to the extraction of gasoline from casing-head gas may, however, be 50 per cent. or more, because of the higher gasoline content of this gas. The heating value is, however, still very high; as much as 1500—1800 B.Th.U. per cb. ft., owing to the preponderance of the

hydrocarbons ethane and propane, with heating values of 1800 and 2500 B.Th.U., respectively.

Natural gas is sold at prices ranging from 30 to 75 cts. per 1000 cb. ft.; but little artificial gas of 500 to 600 B.Th.U. per cb. ft. is sold for less than \$1.00 per 1000 cub. ft. in the United States.

The extraction of gasoline from natural gas is a real conservation measure. Most of the casing-head gas thus treated formerly went to waste, after the relatively small requirements of the leases for drilling and pumping wells had been satisfied. The gasoline extracted from dry natural gas sells for much more in that form than in the form of vapour mixed with the gas and supplied for heating and lighting purposes.

Absorption plants remove much water vapour from the natural gas. This is an advantage because in cold weather this water deposits in low places in the mains and freezes, breaking or choking the pipe and thus diminishing the output. The removal of the gasoline vapour also lengthens the life of rubbers in the patent pipe-couplings used on all main gas-lines. Some of these mains are 20 in. in diameter and several hundred miles long, and are connected with hundreds of miles of other pipes with diameters down to 1 in.

CHEMICAL INDUSTRY CLUB

Mr. A. Gordon Craig, Chairman of the Executive Committee of the Chemical Industry Club, presided at the fourth annual dinner, which was held in the Connaught Rooms, London, on November 24. Lord Riddell was the principal guest, and there were also present Sir William Alexander, Sir Max Muspratt, Mr. Rosecoe Brunner, Mr. T. R. Duggan, Sir William Pope, Dr. E. F. Armstrong, Mr. A. Chaston Chapman, Prof. F. G. Donnan, Mr. P. A. Ellis Richards, Mr. J. Arthur Reavell, Dr. Herbert Levinstein, Mr. E. V. Evans, Mr. W. J. U. Woolcock, Mr. S. H. Burford, and Mr. J. A. D. Mackay (Master of the Tallow Chandlers Company).

Lord Riddell, in proposing "The Profession and Industry of Chemistry," said that he had no doubt been asked to propose the toast because he knew less about chemistry than anyone present, but during the dinner he had put a few questions to the chemical pundits near him, and he gathered from them two things, first, that the position of the chemical trade now was much superior to what it was before the war, and secondly, that the chemical trade was one of those businesses in which there was very little money. However, he discounted the latter statement because he very often went to trade dinners and he always heard the same story. Therefore, he was not surprised to hear that while the chemical industry was doing well in a way, it was doing badly financially. He knew sufficient of chemistry to know that British chemistry had a glorious tradition. It was the custom here to run our country down and other countries up; but ours was the best and the most glorious country in the world, because almost every great discovery of importance during the past fifty years had been made by a Briton; that applied especially to the chemical industry. Nearly all the great inventions of the

world had been made by Britons. There was no man on earth who could be found with a brighter mind than a Briton, and he could not help thinking that it would be a good thing if politicians had to attend trade dinners, as he had to, and come into contact with the wonderful men who were silently doing all the wonderful things in science and industry, and so changing the face of the world. They did not write about it, and the general public knew little of what they were really doing. He was glad to learn that greater unity was now prevailing in the chemical industry and he only hoped that that would lead to greater exports, because the future of our country depended upon our export trade.

Prof. F. G. Donnan made a humorous reply to the toast, and was followed by Mr. Roscoe Brunner, who said that he had that morning presided at a meeting of the Joint Industrial Council for the chemical industry, where they were lectured by one of the labour men upon brains and how to put them into industry. This man said that he had lately met a man who had so successfully put brains into his business that he had not reduced wages but had been able to lower his wages bill by £20,000 during the past year. He recommended that idea of putting brains into business to all who were connected with the chemical trade, but he entirely agreed with Lord Riddell that Britishers were far too apt to belittle themselves, and he had represented, on behalf of the chemical trade as a whole, to that meeting of the Joint Industrial Council that the chemical industry had always put brains into the business and was putting more brains in now than ever before. Some of those in the industry had been looking to the Club to help bring about greater unity, and they had also been looking to the Federal Council for Pure and Applied Chemistry. It was to be hoped that their efforts might be successful in bringing together the warring but friendly societies which represented the chemical profession and the chemical industry. They all looked forward to the Club doing a great deal for those warring elements, which, it was hoped, would become very much more friendly in the future, to the great advantage of the profession and industry.

Brigadier-General Sir William Alexander, proposing "The Chemical Industry Club," said the history of the Club was a short but glorious one; it was doing a great deal of good. Lord Riddell had pointed out how Britons had usually been the initiators of new inventions, but initiation did not mean everything. There was development after the invention, and if we paid more attention in the future to development we should reap the financial benefits which hitherto we had allowed others to take from us. He had recently returned from America, where he had been the guest of the Chemists' Club of New York. That, to him, was a wonderful institution which brought together chemists of all classes. He hoped that in time we should have in this country a club on the same lines, where chemists from all parts of the Empire and America could meet and converse.

Sir William Pope, who replied, said there was a danger of chemists getting into boastful habits, after the very fine speeches that had been heard that evening. He looked to the Chemical Industry Club to play a very great part in pulling together the various chemical interests in this country, and what they really wanted now was the

assistance of men like Sir William Alexander and other leaders of chemical industry to come and help the Club, and to assist in launching it on to a much broader basis. Although they had every reason to be proud of what the Club had already done, all associated with the profession should put their heads together and endeavour to raise the status of the Club, and make it a still greater factor in the advancement of chemical industry and chemical science.

Mr. C. S. Garland, M.P., proposed the Guests, and made special reference to the presence of Sir Max Muspratt and Mr. Duggan.

Sir Max Muspratt, replying to the toast, said he was an extraordinary believer in the human touch in industry. A short time ago he was asked to give an inaugural address at the new Widnes Chamber of Commerce and he chose as his subject "The Human Factor in Industry." He ventured to say there at some length what he would now say in a very few words. There was an absolute necessity that we should allow the human element and the human conception to enter into our industry and our science. Many of the things that Lord Riddell had said were absolutely true. We Britons did underestimate ourselves; we had a certain amount of reserve and thought it was bad form to talk about what Britons had done in industry and science; that was because we did not understand and trust one another sufficiently. No body of friends had the slightest objection to one or the other blowing his own trumpet in reason. The other extreme of not blowing one's trumpet because we were not friends, meant that the whole of the British Empire was losing a valuable asset. We wanted, from the smallest laboratory boy to the biggest professor, to learn that we are all members of a great body of scientists and industrialists. We wanted it to be realised from the most humble apprentice in the works to the chairman of the biggest company that we are all one body striving with heart and soul to keep England in its proud position at the head of the chemical industry of the world; and it was because functions like this helped many members of the chemical industry and profession to realise that human touch that he would always be proud to be present, whether as a guest or as the humblest member.

Mr. T. R. Duggan (Chemist's Club, New York) was also called upon to reply. He said it was twelve or fourteen years since he had had the pleasure of speaking to an English audience. He was in the habit of speaking to Americans, and it was very easy to speak to Americans, whereas it was not so easy to speak to Englishmen. They had made very kind references to the Chemist's Club of New York, and he could only repeat that its members would be extremely pleased to welcome any members of the British Chemical Industry Club at any time they should find it possible to visit New York. Already there had been considerable intercourse between the two Clubs, thanks to the efforts of Mr. Coley, the secretary of the Chemical Industry Club. The New York Club was started many years ago, and it might surprise some of them to know that it owed its existence to Dr. Schweitzer, who was an extremely clever man, a German, but a naturalised American citizen. The American Club had good premises, thanks to the generosity of a chemical manufacturer, which were worth £150,000, half of which was mortgaged. The premises consisted of ten floors,

and there were thirty rooms, of which twelve were for residential purposes. The New York Club found it essential to have resident members; they helped considerably in bringing to the Club those who would not come if they were not sure of meeting someone. He himself had lived at the Club for eleven years. In many ways the Club premises in Whitehall were better than those in New York because in New York the restaurant did not pay, and if the London Club moved into larger premises than those at Whitehall Court and started its own restaurant it might have the same experience. The difficulty in that case was that on certain days of the week there were hardly any members using the Club and yet the staff had to be maintained all the same. In New York they had a staff behind the restaurant of fifteen which had to be kept up, and sometimes there were two waiters to one diner. It had been mentioned that he was one of the original members of the Society of Chemical Industry; he was one of the original starters of the Society, not the original that they had in mind, but the original before that. There was a dispute as to when it was started. It was not started in the north of England but in London by "Tommy" Tyrer one night towards the end of 1880. He himself had to go down to the Institute at Finsbury and there was a party of fifty or so present, which formed the nucleus of the original Society of Chemical Industry. There was another meeting in the following January at which 150 were present, and he was on the committee which was formed at the first meeting. For some reason he was not on the second committee, but that was the real history of the start of the Society of Chemical Industry. Unfortunately "Tommy" Tyrer was no longer with us, but his son would probably remember the meeting.

Proposing the toast of "The Chairman," Dr. E. F. Armstrong said Mr. Craig was a chemical merchant, but there were several kinds of chemical merchants. There was the chemical merchant of the very highest class who rubbed off the German labels from the bottles before he placed his own upon them; there was the chemical merchant who glued his own label, a great big one, on top of the German label; and then there was Mr. Gordon Craig. He thought the Club was very fortunate in having him as its chairman.

The Chairman, in reply to the toast, assured those present that if ever he did deal in German goods he informed his customers that they were German. As to the Club, he wished to emphasise the fact that it was a social club. It was a live club and a growing club, and it was intended that the club should grow and outgrow its present premises. As chairman of the Executive he wished to say that they felt they were on the right lines. They now had the support of the most eminent members of the chemical industry and of the Federal Council on the Executive of the Club, which was a great asset. It was also to be emphasised that the Club was intended for recreation and for bringing all classes of chemists together, from the academic man right down to the humble merchant, such as himself. It might be that they were sometimes not in sufficiently close touch with the manufacturers; well, here was the opportunity to get into close touch with one another and discuss everything from their own points of view. That was what the Chemical Industry Club wanted and aimed at.

SOCIETY OF CHEMICAL INDUSTRY

NEWS FROM THE SECTIONS

EDINBURGH AND EAST OF SCOTLAND

Dr. H. E. Watt presided at the meeting which was held in the Hall of the Pharmaceutical Society, Edinburgh, on November 14. The admission of seven associates was approved.

Prof. G. Barger delivered an address on "Some Recent Advances in Biochemistry." After a short retrospect of the early beginnings of biochemistry, the lecturer dealt with recent work on the proteins by Dakin and others, particularly that relating to partial racemisation. Dakin's explanation of this phenomenon makes clear the possibility of a separate protein for each species; this is known to be the case with the albumin of the egg of the duck and the hen, the difference between the two proteins having been demonstrated by their anaphylactic relationships. It also explains in part the difficulty of synthesising proteins, as the use of alkali in connecting up different amino-acids will bring about partial racemisation. By the use of butyl alcohol and continuous extraction of the amino-acids from solution in water, Dakin found in casein β -hydroxy-glutamic acid, an amino-acid which had not hitherto been detected and which constitutes 10 per cent. of the weight of the protein. Perkin and Robinson's work on harmine and harman was then briefly described, and also recent work on hormones and on the extraction of the very active substance thyroxin from the thyroid gland and of insulin from the islets of Langerhaus. An important development in the therapeutic application of chemistry is the production by the Bayer Company of a substance which is a specific remedy for sleeping sickness, and whose efficiency lies in its power of preventing the fission of the trypanosomes. Of considerable interest in connexion with physiological effects and chemical constitution is the *syn*-oxime of perillaldehyde, which has been prepared in Japan from the essential oil of *Perilla nankinensis*, and is claimed to be 2000 times as sweet as sugar, although the *anti*-oxime of the same substance has a bitter taste. In conclusion the lecturer described the production of glycerol from sugar by alcoholic fermentation in alkaline medium.

NOTTINGHAM

At the meeting held on November 22, Mr. S. F. Burford presiding, Mr. S. R. Trotman read two papers, one on "Bleaching Cotton with Hypochlorous Acid," and the other, in conjunction with Mr. D. A. Langsdale, on "The Action of Ozone on Wool and Chlorinated Wool."

In continuation of work already described (*cf.* J., 1922, 219r) the bleaching of cotton by hypochlorous acid was further investigated. Hypochlorous acid itself, and a solution made from bleaching powder and boric acid, showed very similar rates of absorption by the fabric. The absorption from bleaching powder is much more gradual. The hypochlorous bleach gives whiter goods, the percentages of ash and oil are lower, and the copper value (an index of the oxycellulose formed) is much lower than that obtained by the usual process. The use of hypochlorous acid obviates the necessity for a "sour," and hence saves both material and one handling of the goods.

When commercial chlorinated wool was exposed to the action of ozonised air for a week, all the effects of chlorination already described (*loc. cit.*) are accentuated. The proportion of fibres damaged by the loss of their epithelial scales is increased, and the amount of wool dissolved by alkalis is greater, but there is a loss in felting power and elasticity. Very similar effects are produced by other agents, e.g., *Bacillus subtilis*, which are capable of destroying the scales of the wool fibres. All these results give a foundation for the complaints that unshrinkable wool does not wear well.

LIVERPOOL

A special meeting of the Section was held in the University on November 29, under the scheme for co-operation between this Society and the Chemical Society. Mr. A. T. Smith occupied the chair, and about 60 members, Fellows of the Chemical Society and friends, were present. Prof. E. C. C. Baly delivered a lecture on "Photo-catalysis, Part III.: The Photosynthesis of Naturally-occurring Nitrogen Compounds from Carbon Dioxide and Ammonia," in which he summarised the work on this subject done by himself, in collaboration with Prof. I. M. Heilbron and Mr. H. J. Stern. The chairman, Prof. Heilbron, Capt. F. A. Freeth, Mr. A. Morton, Mr. H. M. Langton, Dr. C. H. Clark and Mr. R. Thomas took part in the discussion.

The Annual Dinner of the Section, in conjunction with the Liverpool and North-Western Counties Section of the Institute of Chemistry, was held on December 2 in the Midland Adelphi Hotel, and was attended by over 120 members and friends. The chair was taken by Dr. F. J. Brislée, chairman of the local Section of the Institute of Chemistry, and among the guests were the President of the Society and Mrs. Armstrong, the Lady Mayoress of Liverpool, Sir Max Muspratt, Bt., the Hon. W. and Mrs. Hulme Lever, Mr. John Gray, Dr. G. C. Clayton, M.P., Mr. Horatio Ballantyne, Alderman and Mrs. W. Muirhead, the Town Clerk and Mrs. Moon, Dr. J. P. Longstaff, and Mr. R. B. Pilcher. After a short toast list, the remainder of the evening was devoted to music and dancing.

OTTAWA

The first meeting of the current session was held on November 9, the subject of discussion being "Domestic Fuel Problems." Mr. Hambly occupied the chair; fifty members and friends were present. In introducing the subject the chairman briefly referred to the problems met with in firing both industrial and domestic furnaces.

The characteristics of different types of fuels were dealt with by Messrs. R. E. Gilmore, J. H. H. Nicolls, and H. Kohl under the following heads: (a) the relative value of chemical and physical analysis of coal and other fuels; (b) the classification of the higher types of fuels; and (c) the ignition temperature of different fuels.

Chemical analysis involves the determination of moisture, ash, volatile matter, and fixed carbon. The moisture and ash determination tell what quantity is not real fuel. The volatile matter indicates whether the fuel is smoky or not and the fixed carbon shows how much coke or charcoal a given fuel will yield. Physical analysis includes the handling, storage and burning qualities. The classification of coal into anthracite, semi-anthracite, semi-bituminous, etc. is accomplished by

chemical analysis, but this must not be done without taking into account the physical characteristics. If to a chemist's certificate of analysis were attached an interpretation of the results of analysis, the layman or semi-technical man would place more value on chemical analysis than he usually does.

The Welsh coal now sold in some Canadian cities comprises at least four different grades, and the trouble with it is not due to its chemical, but to its physical properties, particularly its hardness. If the best grades of Welsh anthracite were screened and graded before selling to the consumer, they would be equal to, if not better than, the best grades of Pennsylvania anthracite. American anthracite is, however, considered the standard household fuel, and as long as this supply is available it looks as if only the price factor will control its use.

The various methods of determining the ignition temperature of coal were fully described.

Mr. E. S. Malloch outlined the practical operation of a hot-water furnace with each of the different types of fuel, and described the results obtained in each case.

BIRMINGHAM

A joint meeting with the Midland Counties Section of the Institute of Brewing was held in the University of Birmingham on November 23, when Dr. E. B. Maxted presided and Prof. A. R. Ling read a paper on "Starch and its Estimation in Barley and in Wheat."

After discussing the economic importance of starch, Prof. Ling said that in the absence of an accurate method of estimation the practice had arisen of expressing the starch content by difference as "nitrogen-free extract." This, like most of the methods of estimating starch, was inaccurate and attention was therefore devoted to the researches of C. O'Sullivan and Horace T. Brown, which provided a basis for further inquiry. It had been found that the percentage of apparent maltose produced at the end of, say, 1 hr. by hydrolysing starch with malt diastase bore a constant relation to the starch originally present. To apply this method in practice it was necessary to determine how the percentage of apparent maltose produced by hydrolysing starch varied with the diastatic power of the malt employed. This had been done, and extremely pure wheat and barley starches had been found to give identical results on hydrolysis, due allowance being made for variation in the diastatic power of the malt. The method finally evolved may be summarised as follows:—About 5 g. of finely-ground grain is extracted in a Soxhlet extractor with alcohol (sp. gr. 0.920) for 2 hrs., to remove the sugars, fats and certain proteins. The residue of starch is washed into a beaker, gelatinised by boiling for 10 minutes, cooled to 57° C., and hydrolysed with 10 c.c. of malt-extract of diastatic power 70° (Lintner) for 1 hr., with constant stirring. After boiling, the conversion liquid, together with the washings of the residue, is filtered and made up to 200 c.c.; 30 c.c. of this solution is diluted to 100 c.c. and titrated against 10 c.c. of Fehling's solution. A blank experiment, using water and malt extract only, is carried out in the same way as the actual conversion to enable a correction to be made for the reducing bodies present in the malt

extract. The percentage of starch is calculated by the formula $S = 9.173 M'/M$, in which S is the percentage of starch in the sample, M the percentage of apparent maltose produced from dry barley or wheat starch from malt of known diastatic power (given in the form of a graph) under definite conditions, and M' the percentage of apparent maltose yielded by the sample under the same conditions, and with malt of the same diastatic power. The method has given accurate results with barleys and wheats from the Rothamsted Experiment Station and the Olympia Agricultural and Research Station, Offchurch.

In the discussion Capt. H. J. Page said that the method was valuable and gave very concordant results which accorded with the percentages of starch they expected to find in barleys and wheats. He hoped that the method would be extended to apply to other starches.

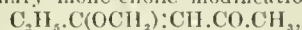
A special meeting, to which Fellows of the Chemical Society resident in the Midlands were invited, was held on December 5, in the University.

Dr. E. B. Maxted presided, and the following three papers were presented by Prof. G. T. Morgan and his associates:—(1) Researches on Residual Affinity and Co-ordination. Pt. XV. Interactions of Acetylpropionylmethane and the Tetrachlorides of Selenium and Tellurium (with Mr. H. G. Reeves).

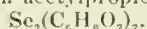
(2) The Upper Limit of Diazotisability in the Benzene Series: Aminomesitylene-*bis*-diazonium Salts (with Mr. G. R. Davies).

(3) Studies in the Normal Butyl Series. Pt. II. The Four Stereo-isomeric $\beta\gamma$ -Di-*p*-tolylamino-*n*-butanes.

(1) The tetrachlorides of selenium and tellurium each induce characteristic tautomeric changes in reactive β -diketones such as acetylacetone and its homologues. Acetylpropionylmethane (propionylacetone), preferably in the form of its copper derivative, behaves towards selenium tetrachloride in its ordinary mono-enolic modification,

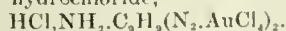


and yields selenium acetylpropionylmethane,



With tellurium tetrachloride, acetylpropionylmethane reacts in its methylene-enolic form, $\text{C}_2\text{H}_5\text{CO}\cdot\text{CH}_2\cdot\text{C}(\text{OH})\cdot\text{CH}_3$, giving rise to tellurium acetylpropionylmethanedichloride, $\text{Te}(\text{C}_6\text{H}_5\text{O}_2)\text{Cl}_2$. On reduction this dichloride furnishes tellurium-acetylpropionylmethane, $\text{Te}(\text{C}_6\text{H}_5\text{O}_2)$, a substance having an intense bactericidal action.

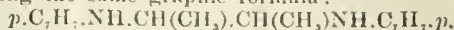
(2) When treated with three molecular proportions of nitrous acid, triaminomesitylene hydrochloride in acid solution is diazotised only in two of its amino-groups, yielding aminomesitylene-*bis*-diazoniumchloride identified by conversion into aminomesitylene-*bis*-azoimide $\text{NH}_2\cdot\text{C}_6\text{H}_3\text{N}_6$ and the aurichloride hydrochloride,



When, however, this diazotisation with excess of nitrite is effected in presence of hydrazoic acid, the formation of the foregoing *histriazo*-compound is followed immediately by the diazotisation of the third amino-group, thus leading to the production of *tristriazomesitylene*, $\text{C}_6\text{H}_3\text{N}_9$. It is inferred from these results that in a monocyclic triamine of the benzene series, only two of the three amino-groups can be diazotised concurrently. The diazotisability of the third amino-group is manifested only after the two first-formed diazonium complexes

have been substituted by other groups, such as the triazo-radicle.

(3) When $\beta\gamma$ -dichloro-*n*-butane, or the corresponding dibromo-compound, is condensed with *p*-toluidine, two isomeric diamines are produced having the same graphic formula:



The less fusible isomeride is a racemoid substance resolvable by the aid of *d*-*o*-bromocamphor-*R*-sulphonic acid, into two optically active enantiomorphs, *d* and *l* $\beta\gamma$ -di-*p*-tolylamino-*n*-butane. The more fusible isomeride, which is non-resolvable, is meso- $\beta\gamma$ -di-*p*-tolylamino-*n*-butane. These four stereoisomeric modifications of the same diamine furnish a complete analogy with the four stereo-isomeric tartaric acids, this being the first instance in which a complete set of four basic substances containing two asymmetric carbon atoms has been isolated in definitely crystalline forms. During the condensation between *p*-toluidine and the dihalogenated *n*-butanes a basic by-product is isolated, yielding characteristic bright yellow salts, and identified as 3,5,7-trimethylacridine.

MANCHESTER SECTION AND THE CHEMICAL ENGINEERING GROUP

A joint meeting of these organisations was held in the Textile Institute, Manchester, on December 1, when Mr. W. G. Fraser read a paper on "The Chemical Engineering of Paper Manufacture." In the abridged form of the paper, as circulated, a brief outline is given of the processes and plant used in the manufacture of paper from various raw materials. The digestion and bleaching operations are described, and reference is made to the importance of beater design on the character of the beaten pulp; for example, with a high backfall close up to the roll, hydration takes place rapidly, whilst with a backfall more tangential and further away from the roll, hydration takes place less readily. Some interesting facts are noted regarding the consumption of water and coal in a paper mill; the quantity of water, including that used in steam-raising, varies from 100,000—150,000 galls. per ton for rag papers to 10,000—12,000 galls per ton for newsprint. The amount of coal may vary from 6—7 tons per ton of rag papers to 16—17 cwt. for newsprint. A table is given showing the approximate quantity of coal used for each operation in a mill which consumed 720 tons of coal in the manufacture of 265 tons of paper.

LONDON

On December 4, in the Engineers' Club, Dr. G. Scott Robertson, chemist to the North of Ireland Government, and Mr. F. Dickinson read a paper on "The Valuation of Insoluble Phosphate by means of a Modified Citric-Acid Test." Mr. E. V. Evans presided over a small attendance.

After enumerating the different kinds of insoluble phosphatic fertilisers, the authors draw attention to the insufficiency of the official citric-acid test when applied to low-grade basic slags, particularly fluorspar slags, and rock phosphate. If 1 gram of phosphate be used in the test, instead of 5 g., the analytical results give a much better indication of the fertilising value.

The discussion served to show up the extremely empirical nature of the citric-acid test, and left the impression that it is advisable to work out a new test, based on scientific principles.

THE JOURNAL

On several occasions in the past the Council and the Publications Committee have considered the feasibility of issuing the *Journal*, or a part of it, weekly instead of twice a month; but there were always obstacles which could not be overcome. Now, however, conditions appear to be more favourable, and the Council has decided to publish a weekly *Journal* from the beginning of next year.

At the October Meeting of Council, it was resolved, on the motion of Sir William Pope, chairman of the Federal Council, to issue the "Review" section as a separate weekly periodical, under a new name, and as the official organ of the Federal Council. To make the necessary arrangements the Council appointed the following to act as an Executive Committee:—Sir W. Pope, Dr. E. F. Armstrong, Mr. E. V. Evans, Dr. S. Miall, Mr. F. H. Carr, Mr. W. J. U. Wooleock, and Mr. C. S. Garland. In its report, presented to the Council in November, the Committee recommended: that the weekly journal should be called "Chemistry and Industry"; that for a period of one year copies of it should be placed at the disposal of the Chemical Society for distribution among those of its Fellows who are not members of the Society of Chemical Industry; and that the editorship should be offered to Dr. Stephen Miall, as the Committee had failed to come to terms with the present "Review" Editor. In accepting these proposals, the Council expressed the wish that, if possible, Abstracts and Transactions should also be issued weekly, under the same cover. The Executive Committee has since decided that this course will be practicable, and, accordingly, arrangements are now being made to issue:—(a) a weekly journal bearing the two titles "Journal of the Society of Chemical Industry" and "Chemistry and Industry," to be sent to members and subscribers at existing subscription rates; and (b) "Chemistry and Industry," under a separate cover, at a charge of 6d. per copy, or 2ls. per annum (25s. abroad). The advertisements will appear in both issues.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF GLASS TECHNOLOGY

The meeting held on November 22 in the University of Sheffield opened with the presentation of the Frank Wood medal, established in honour of the Society's first president, to Messrs. G. G. Middleton and H. W. Howes, students in the Department of Glass Technology of the University. In presenting the medal, Mr. Frank Wood expressed appreciation of the honour of having his name associated with it.

Prof. W. E. S. Turner then described his recent visit to investigate the position of the glass industry in Czechoslovakia. After sketching the difficult economic position, he said that the industry was by no means as advanced technically as the British industry, but was living largely on tradition and existing knowledge. Hardly any machinery was used and hand-work predominated. Much money was made during the boom years 1919 and 1920, and but little had been spent on improving the industry, whereas, despite taxation, British manufacturers had invested large sums in improving and extending their works and plant.

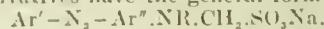
From a technical point of view this country surpassed the Continent in many respects, and he hoped that the effect of this technical superiority would soon be evident.

A paper on the use of selenium for producing colourless glass was presented by Mr. A. Cousen, who described a large number of experimental melts made to determine the effect of various batch materials on the decolorising power of selenium. Details were also given of a series of melts designed to show the influence of the duration of melting on the colour developed.

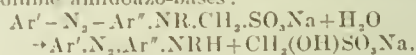
SOCIETY OF DYERS AND COLOURISTS

At the meeting of the Manchester Section, held on November 17 in the Chemical Lecture Theatre of the University, a paper on "Ionamines: a New Class of Dyestuffs for Acetate Silk," by Prof. A. G. Green and Mr. K. H. Saunders, was read by Prof. Green.

Earlier work has shown that although the variety of artificial silk known as "acetate silk" possesses little or no affinity for acidic or direct cotton dyestuffs, it exerts a considerable attraction for many basic compounds and for certain azo dyestuffs in which sulphonic groups are absent. In dyeing with a basic dyestuff it is the base itself which is taken up by the fibre, and if the dyestuff is applied in the form of a salt this must be readily dissociated by water. In the attempt to obtain a class of dyestuffs specially suitable to this material the authors were led to investigate the suitability of methyl- ω -sulphonic-acid derivatives of amidoazo-compounds. These derivatives have the general formula



They are readily soluble in water, and are easily hydrolysed by dilute acids or alkalis with formation of insoluble amidoazo-bases:



It was therefore to be anticipated that if the hydrolysis were brought about in the dyebath in presence of acetate silk the latter would be dyed by the liberated base.

Experiment confirmed this, and a series of new dyestuffs termed "Ionamines," based upon this discovery, are now being placed upon the market by the British Dyestuffs Corporation.

Ionamines derived from primary amines, or which contain a free primary amino-group, are capable of being diazotised on the fibre and on development give a wide range of shades from orange to scarlet, red, maroon, violet, blue and black. The direct shades are at present limited to yellow, orange, red and violet.

Those Ionamines which have an affinity for cotton are found to have a smaller affinity for acetate silk, whilst the Ionamines possessing the best affinity for acetate silk have none for cotton. The effect on wool is curious. The omega-sulphonic acids dye wool exactly as other acidic dyestuffs and the omega-sulphonic group is thus protected from hydrolysis. With natural silk the dyestuff appears to be partially hydrolysed, but the investigation in this direction is incomplete.

The new dyeing process differs from the ordinary processes of dyeing in that chemical change is involved. There is thus no possibility of "levelling-up" an uneven shade by longer heating in the bath. The material is best entered at a low temperature and the bath raised slowly to 65–75° C. Dyeing is

facilitated by the presence of small quantities of either acids or alkalis. For diazotisation a weak acidified bath of sodium nitrite is employed, reaction being complete in about five minutes. Only developers containing no sulphonic groups can be utilised, the most generally useful being resorcinol (neutral), beta-oxynaphthoic acid (slightly acid with acetic) and beta-naphthol (weakly alkaline). The colours obtained with these developers and four typical Ionamines are the following:—

	Direct	Resorcinol	Beta-naphthol	Beta-oxynaphthoic acid
Ionamine A	Yellow	Red-brown	Red-purple	Navy blue
Ionamine B	Orange	Red-orange	Scarlet	to black
Ionamine H	Orange-yellow	Red-brown	Red-purple	Crimson Purple
Ionamine L	Dull yellow	Purple-brown	Purple	Bright blue

Interesting effects are produced on mixtures of cotton and acetate silk. By a suitable selection of direct cotton dyestuff and Ionamine, the two fibres can be dyed either in different colours or in a solid shade. This can be done either in a single bath or by "cross-dyeing."

The peculiar properties of the Ionamines, which can exert at the same time the functions of both basic and acidic dyestuffs, render it probable that other uses may be found for them.

INSTITUTE OF CHEMISTRY

At the annual meeting of the Leeds-Area Section, held in Leeds on November 22, Mr. W. McD. Mackey presided, and Mr. F. W. Richardson read a paper on "The Ethics of Expert Evidence."

There is probably some reason for the disrepute in which expert evidence is held, particularly by the legal profession. In wording reports the public analyst should not allow himself to be led by a bias in order to secure a conviction. Health authorities and the police are frequently victims of the will to prosecute and magistrates are overwhelmed by the impulse to convict; but the attitude of the authorities towards violations of the Food and Drugs Act has improved greatly. Several years ago the speaker, in reporting on a sample of butter deficient in fat, suggested that the cows were either abnormal or fed abnormally and asked for samples of the milk. The report was returned with the remark that it was not for the prosecution to suggest a line of defence. In Court the defence proved that the deficiency in fat was due to excessive feeding on cottonseed cake. Public analysts are thus to some extent at the mercy of the health committee or the medical officer of health, and it is suggested that the public analyst should act in a judicial capacity between the health committee and the offender. It is deplorable that even in some clear case of fraud the defendant has no difficulty in obtaining all the expert help required, and however glaring the adulteration, if the firm is wealthy enough, its case is always supported by an array of leading chemists. Some of these experts, whilst admitting the accuracy of the prosecution's data, attempt to confuse the issue by raising subsidiary questions. Such jugglery, which at times deludes the magistrate, is to be resented and there is need of a special committee appointed by the members of the Institute of Chemistry to consider cases of unprofessional conduct. Members of the same profession should cease all attempts to score off one another and to gain professional "kudos" at the cost of the opponent's reputation.

THE CERAMIC SOCIETY

At the November meeting of the Ceramic Society Messrs. A. Brittain and C. Elliott read a paper on "The Gypsum Industry." After consideration of the composition and modes of occurrence of gypsum, the authors discussed their investigations on the dehydration of gypsum by heat, as a result of which they concluded that, under technical conditions: (a) in the dehydration of lump gypsum by hot gases, the hemihydrate is formed at a much lower temperature than that existing at the surface, there being an inversion point at about 100° C.; (b) in the calcination of finely-ground gypsum, the production of hemihydrate occurs within the temperature limits of about 109°—130° C.; (c) the hemihydrate-soluble-anhydrite change occurs within the temperature zone of about 160°—200° C., the product being practically anhydrous before the further rise in temperature occurs.

Processes for the dehydration of gypsum were described, and a general comparison was made in regard to power required for equal output and fuel consumption. Detailed reference was made to certain recent applications of plaster.

Commercial plasters, according to the temperature and time of calcination, may contain (besides the moisture and impurities present in all commercial plasters) varying proportions of: (1) unchanged gypsum; (2) hemihydrate; (3) anhydrous calcium sulphate in the form of (a) soluble anhydrite, which readily absorbs water and reverts to the hemihydrate; (b) slow-setting anhydrite, which absorbs water slowly and sets with hardening; (c) dead-burnt plaster and anhydrite, which do not rehydrate with water. Unchanged gypsum acts as an accelerator to the setting of plaster, whilst slow-setting anhydrite acts as a retarder. The desirability of standardising the various tests for plaster was strongly urged.

THE FARADAY SOCIETY

At the annual meeting, held in the Chemical Society's Rooms, Burlington House, W., on November 20, Prof. A. W. Porter announced that Sir Robert Robertson had been elected president of the Society, and that future annual meetings would be held in May.

Sir Robert Robertson, in the chair, introduced the following papers to the meeting:—(1) "Intra-Molecular Ionisation," by Prof. T. M. Lowry; (2) "The Viscosity and Molecular Dimensions of Hydrogen Selenide," by Mr. C. J. Smith; and (3) "The Hydrogen-ion Concentration of Natural Waters and some Etching Reagents and their Relation to Action on Metals." Two papers by Mr. E. W. J. Mardles on "Viscosity Changes Associated with the Gel to Sol Transition," and "The Scattering of Light by Organosols and Gels of Cellulose Acetate," were postponed.

(1) Dr. Lowry showed that the hypotheses of Covalency and Electrovalency in conjunction with the octet theory can account for previously supposed cases of variable valency. The familiar cases of intra-molecular ionisation of the organic amino-acids have led the author to suggest electronic formulæ for various organic compounds. The increase in the stability of the oxy-acids of chlorine, sulphur and phosphorus with increase in oxygen-content, can be shown to be due to the positive charge on the central atom of the ion. The effect of the addition of oxygen in modifying the acidity

of certain compounds can also be shown to be due to the positive charge on the central atom of the ion, and apparent discrepancies, *e.g.*, hypochlorous acid, are explicable on the assumption that the oxygen atom occupies the central position in the molecule in place of the chlorine atom. The decrease of acidity in passing along the series perchloric, sulphuric, phosphoric, and silicic acids may be associated with the diminishing positive charge on the central atom of the ion, as well as with the reduction in the mass of the nucleus. In the discussion that followed Dr. Lowry defended the use of the term "ionisation" in opposition to the view expressed by several speakers that the word "polarisation" was preferable.

(2) In continuation of researches with Prof. A. O. Rankine, Mr. C. J. Smith has shown that the results obtained for the viscosity of hydrogen selenide are consistent with those previously obtained for krypton, hydrobromic acid and arsine. The research was rendered difficult by the instability of hydrogen selenide; by comparison with air at 20° C. and assuming the constancy of Sutherland's constant, the mean collision area of the gas was found to be 0.86×10^{-15} cm. The method of dividing the mercury pellet in the viscometer into two pellets for correction purposes seems capable of wider application.

(3) Dr. Atkins has estimated by means of "buffer" solutions the influence of peat, carbon dioxide, glass, rubber, calcium and magnesium carbonates on the hydrogen-ion concentration of various natural waters, and he suggests the use of acids of relatively low hydrogen-ion concentration and of "buffer" mixtures as etching reagents for metals.

FEDERAL COUNCIL FUND

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NEWS AND NOTES

CANADA

Pulp and Paper

The Howard Smith Paper Mills, Ltd., is erecting at Cornwall, Ont., a mill with a capacity of about 15,000 tons per annum of bleach soda pulp. Poplar wood will be the chief raw material.

Work is progressing rapidly upon the erection of the large paper mill of the Backus Company at Kenora, Ont. When completed the output of newsprint from this mill will be 1000 tons daily.

Operations have commenced at the new mill of the Temiskaming Pulp and Paper Co., recently erected at a cost of approximately \$1,000,000. The plant will have a daily production of 40 tons of ground wood pulp, which will be shipped to Chicago, Kalamazoo, and points in the State of New York.

The large pulp and paper mill which is to be built at Phillips Bridge, nine miles south of Elko, upon the Elk River, B.C., has been promoted mainly by the *Chicago Tribune* and other newspapers. The company will be known as the Wigwam Pulp and Paper Co., Ltd.; the plant is to cost \$10,000,000 and employ about 1500 hands.

Engineers of the Armstrong Whitworth Co. have proceeded to Newfoundland to establish a large pulp and paper plant in that colony. The *Toronto Globe* states that the British Government has guaranteed \$10,000,000 on the recommendation of the Trades Facilities Board, to assist the enterprise at Humber, Newfoundland, and the Newfoundland Government has guaranteed a like amount.

It is stated that the control of the Belgo Paper Co., which has been organised to take over the Belgo-Canadian Pulp and Paper Co., will rest in Canada, thus ceasing to be in Belgium. The new company has an issued capital of \$14,000,000, out of an authorised issue of \$20,000,000, and there are also \$1,500,000 of bonds. The output will be increased from 200 to 360 tons daily. The head office will be in Montreal.

Mining and Metallurgy

The Cariboo-Gold Platinum Extracting Co., at Quesnel, B.C., is erecting a plant to handle 10 tons of black sands daily; the sands contain the metals of the platinum group.

It is reported that radium has been found in lead deposits on the south branch of the Petawawa River, 18 miles north-west of Pembroke, Ont. Reports from the United States Radium Co. and the Keystone Metal Reduction Co. state that the radio-activity is equal to that of the carnotite ore in Colorado.

The entire matte production of the Mond Nickel Co. has been shipped from Coniston, Ont. There have been forwarded to Wales 140 earloads in September, 137 in October, and 138 in November. It is expected that the Mond nickel refinery at Clydach will be operating on a pre-war scale before the end of the year.

The monthly sales of the International Nickel Co. are now approximately 1.5 million lb. of nickel and 400-500,000 lb. of monel metal. Before the Canadian company can fully provide for expenses the nickel sales must approach 2 million lb. monthly. The monthly output in pre-war times was between 3 and 4 million lb., and during the war it reached 8 million lb. Since the international disarmament

programme came into existence the company has been endeavouring to find new uses for nickel. The mills at Huntington, W. Va., which cost \$3,500,000, were erected with this end in view. The company has recently resumed operations on a small scale at its Creighton mine and at the Copper Cliff reduction works; the refinery at Port Colborne, Ont., is working at capacity.

FRANCE

Industrial Notes

Chemical Industry.—Raw materials have risen in price with the appreciation of the pound sterling and home buyers have restricted purchases as much as possible. Practically all contracts now contain a clause providing for cancellation if the exchange value of sterling rises above a certain level. Prices of turpentine oil have risen by from 10 to 15 fr. per 100 kg., and quotations for copper and lead salts are higher, owing to the firm prices of the corresponding metals, new or scrap. Consumption of bichromates, sodium sulphide, ferrocyanides and ferricyanides is increasing steadily and prices are rising despite Belgian competition, particularly in the north and north-eastern regions. Perfumes are in great demand and stocks are practically depleted. There is little activity in the fertiliser market, but the production of phosphatic slags has improved and the demand continues to be very good. Quotations for nitrates are firm; the effect of the recent earthquake on the Chilean production is not yet known, but it is believed that only the ports of shipment are affected. Orders are not being placed for British ammonium sulphate on account of its high price, and as a few more coke ovens are to be lit in the Nord area the French production of the fertiliser is likely to increase.

Metallurgy.—Exportation of iron ore to Germany is increasing, because Germany is not now buying from Sweden. Production of ore is good in France, except in the Pyrenees. Shortage of metallurgical coke precludes the lighting of more blast furnaces and the purchase of English coke at the present rate of exchange is an expensive method of compensating the short supplies from Germany.

Coal.—The demand for coal, especially for industrial use, is excellent in the Nord and Pas-de-Calais districts, and the winter campaign in the Loire and central coalfields is promising. Exports from the Saar district to Germany have slackened owing to the low exchange value of the mark, but Switzerland and Austria are still placing important orders. Imports from Great Britain have increased slightly, but are held back by the exchange. During October France imported 1,768,000 metric tons of coal and 441,000 t. of coke, compared with 1,692,000 t. and 421,000 t., respectively, in September. Exports during October were:—coal 400,000 t., coke 46,000 t., briquettes 11,400 t.

General.—Next year the Lyons Fair will be held in the spring, from March 5 to 17, instead of in the autumn. Russia and the new States in the Near East are interested in the Fair and arrangements are being made to induce visits from potential buyers in Switzerland, Spain and South America, with the object of making the Fair as international as possible.

A Canadian exhibition-train is to visit all the chief industrial centres in France next spring to exhibit products of Canadian manufacture that are

unlikely to compete with French manufactures. The scheme, supported by the State and the railway companies, is similar to that under which a French exhibition-train covered 13,000 kilometres and stopped at 82 towns in Canada last year.

UNITED STATES

Tantalum a Commercial Article

As the result of research extending over six years, a Chicago firm has developed a process for producing metallic tantalum. The metal combines the properties of softness and workability with extreme resistance to wet corrosion and therefore should become a valuable material in industry. It is manufactured *in vacuo* because it must be free from oxygen, hydrogen, nitrogen and other common gases; large-scale production is not expected and the price will prohibit its use for ordinary purposes. Tantalum is not attacked by *aqua regia* or by any acid or alkaline solution, except hydrofluoric acid. Like aluminium it acts as a valve in electric cells, and although a dielectric oxide is readily formed on its surface, thus making it useless as an anode in electrolysis, this property permits its use in electrolytic rectifiers for alternating current. Tantalum melts at 2850° C., but it combines with gases at high temperatures, forming stable compounds that do not readily dissociate at temperatures below the melting-point of the metal. Since 1914, when the German source was cut off, the metal has not been available in the United States, but the possibilities for its use have greatly increased owing to the development of the electrical arts. Dr. C. W. Balke, director of research to the Fausteel Products Co., is investigating the properties of tantalum and also working on the commercial production and utilisation of its sister metal, columbium.

Factors in the Spontaneous Combustion of Coal

In Technical Paper No. 311 of the Bureau of Mines, Washington (price 5 cents), Mr. O. P. Hood reviews briefly the factors concerned in the spontaneous combustion of stored coal. Among such factors are included, superficial area and freshness of the surface of the coal stored, temperature at time of storage, and ventilation of the pile. Spontaneous combustion originates most frequently in fine coal, below 1.25 inch or nut size. The rate of heat generation at a freshly broken surface of coal appears to depend upon the oxygen content of the coal. A freshly broken surface is initially very much more active than after a few weeks, and this factor is of consequence in considering the question of crushing coal prior to storage. Spontaneous fires rarely occur after the coal surfaces have been exposed for three months, and are more liable to occur in coal put into storage during the summer. Should the temperature of the pile reach 140°–150° F., and continue to rise, spontaneous ignition is probable within a few days or weeks. Removal of the pile is necessary if the temperature reaches 160°–180° F. The natural ventilation of a coal pile due to variations in temperature and barometric pressure is considerable and serves to dissipate the heat generated in the pile. Segregation according to size, the larger pieces of coal collecting at the bottom of the pile, with the smaller coal above, is a factor suggesting that spontaneous combustion is initiated somewhere between the two extremes of the central core of fine coal and the large-piece

region, where the ventilating current is just sufficient to supply oxygen for a maximum rise of temperature, and insufficient to remove the heat generated. Some observers state that, in general, fires in large coal piles occur from 5 to 8 feet below the surface, on the flanks of the pile. Factors such as the sulphur and volatile-matter content of coal are regarded as of relatively minor importance in the initiation of spontaneous combustion.

"Anthracol"

This substitute for coal is made by coking a mixture of culm or waste anthracite coal and coal-tar pitch or other bitumens. Tests indicate that it is denser, harder, tougher, and stronger than coke, and that when struck with a hammer or passed through crushing rolls, it breaks with an irregular fracture, similarly to anthracite, but leaves very little fine material. Anthracol can be made in a coke oven upon the same large scale as bituminous coke, and as it can be produced at little greater cost, it should prove a valuable means of utilising the anthracite culm now going to waste. Its commercial development is the outcome of experiments made in 1914 in the chemistry laboratory at Lehigh University. It is stated that only mechanical difficulties of a nature that can be remedied stand between the trial runs and the actual utilisation of anthracol as a domestic fuel; consumers are satisfied with it and it commands the same price as the best anthracite.

AUSTRALIA

The Possibilities of Alkali Manufacture

The committee appointed in 1917 to consider the possibility of manufacturing alkali in Australia has reported that conditions are unfavourable, as the necessary raw materials are lacking. Accompanying this statement is a report by Brunner, Mond and Co., which states that as rock salt or saturated brine is not known to occur in Australia, the suggestion to manufacture alkali by the ammonia-soda process must be abandoned. Manufacture by the electrolytic process is ruled out, owing to the small consumption of chlorine products; if this difficulty were removed the process would be the best suited to Australia. In the meantime the company has decided to form an Australian company to represent it locally. According to Mr. P. J. Blackburn, the report is premature, because the results of boring at Calegero, near Bairnsdale, commenced originally for Messrs. Brunner, Mond and Co., and continued since for the Calegero Salt Mines Co., are promising. The Mount Lyell Chemical Co. manufactures about 500 t. per annum of alkali equal in quality to imported material, but cannot attempt to supply the entire home demand, as the market for caustic soda is so limited. About 7000 t. of lump (double strength) alkali is consumed annually in the Commonwealth.—(*Ind. Austr.*, Sept. 28, 1922.)

SOUTH AFRICA

Alcohol from Prickly Pear

The *South African Journal of Industries* (November issue) states that a new company, the South African Motor Fuel Development Co., Ltd., has been registered at Bloemfontein, with a capital of £100,000. The object of the company is to carry on, in South Africa or elsewhere, the business of manufacturers of and

dealers in industrial alcohol, motor fuel, and fuel for lighting and heating purposes, and by-products arising from such manufactures (vinegar, sugar, syrup, yeast, oil, and fruit jellies). The raw material will be the prickly pear. It is stated that the motor-spirit will be retailed at two shillings per gallon.

There are said to be about 2 million acres of land in South Africa infested with the prickly pear. Nothing is stated with regard to the cost of collection or the means of transport.

GERMANY

Metallurgical Research in 1922

The present condition of the metallurgical industry in Germany renders necessary the most rigid economies in material and labour. To this end an intensive research campaign to investigate the basic principles on which the various processes of smelting and working metals depend has been organised by the Deutsche Gesellschaft für Metallkunde. At the third general meeting of this society, held at Essen from October 14 to 17, a comprehensive programme of economic and practical questions dealing with the metallurgy of non-ferrous metals was discussed. The tendency of German metallurgical development at the present time is to produce suitable alloys of metals derived from domestic ores to replace those made entirely or partly from imported ores, and thus to render the country independent of foreign supplies in case of need. Most attention is being given to the production of aluminium alloys, but increasing interest is being taken in the possibilities of the use of magnesium, calcium, barium, sodium, and silicon alloys.

The Potash Industry

In his report, read to a meeting of the Potash Syndicate on November 19, the managing director (Forthmann) said that sales up to the end of September, 1922, had been very satisfactory, viz., about one million metric tons of pure potash (K_2O), compared with 621,400 t. in the corresponding period of 1921. Home demand was still good, and were it not for the scarcity of railway trucks, the last quarter of the year would also furnish good results. Sales to foreign buyers had also been very good; they were estimated at 1,250,000 m.t. of K_2O , and thus for the first time since the outbreak of war would exceed the foreign sales in 1913 (1,100,000 t.). By a very large majority the meeting approved a new method of fixing net sale prices in order to avoid selling 40 per cent. manure salts, for which there is a large home demand, at prices lower than those of crude salts, which cost considerably less to produce, are much in demand abroad, and therefore bring in much greater net profits.

The Industrial Situation in October

H.M. Commercial Secretary at Berlin states that, despite the further depreciation of the mark, the economic situation changed but little during October, and only a few industries were forced to restrict production or to work for stock. Orders have decreased, deliveries of raw materials have improved, and labour is more plentiful, but the long-feared slump is not yet within sight. The export trade, however, has not revived to the extent anticipated, owing to tariff restrictions in importing countries, strong competition from France and Belgium, and the fact that the cost of production

in many industries exceeds the world's market prices. In the chemical industry, the coal-tar dyo market is very uncertain, few home orders are being placed and foreign orders have decreased. Production is still hampered by shortage of raw materials, particularly soda, salt, and coal, and by transport deficiencies. Many of the smaller and medium-sized factories may have to close down on account of lack of inland orders and scarcity of capital. In Berlin chemical industry experiences difficulty in purchasing foreign raw materials and coal with the mark at its present value, but there is an active demand, both home and foreign, and the factories are fully employed on current orders. The demand for fine ceramic products is good, and foreign trade is satisfactory. The plate-glass industry is more dependent than ever on foreign coal, the situation in the sheet-glass industry remains unchanged, and exports of hollow glass have increased, despite the shortage of soda.

GENERAL

Insulin, The Hormone of the Pancreas

It has long been known that extirpation of the pancreas in animals leads to a fatal diabetic-like condition in which the blood-sugar rises above its normal threshold value, sugar appears in the urine, and glycogen ceases to be stored in the liver. These facts suggest that the condition of diabetes is due to the lack of an internal secretion necessary for the metabolism of sugar. The pancreas contains, in addition to its main cells, which secrete the pancreatic juice through ducts, a number of tiny islets called the islets of Langerhans, which apparently secrete the anti-diabetic hormone, insulin, into the blood-vessels surrounding them. Numerous attempts have been made from time to time to obtain proof of the existence of this endocrine substance, but until quite recently all extracts have had little effect on the blood-sugar when injected into normal animals.

To two young Canadian workers, F. G. Banting and C. H. Best, of Toronto, must be accorded the credit of having first prepared an extract which alleviates the symptoms of diabetes, both in animals and in man, in an exceptionally striking manner. With the aid of J. B. Collip, a process was worked out whereby a potent preparation of insulin could be obtained suitable for clinical trials without undue risk to the patients. It consists briefly in mixing minced ox-pancreas with an equal volume of 95 per cent. alcohol and straining. Two volumes of 95 per cent. alcohol are added to the extract, and the protein precipitated is removed. The solution is concentrated at 18–30° C. and extracted with ether, re-concentrated to a paste, and treated with 80 per cent. alcohol. The supernatant layer when poured into a large excess of absolute alcohol deposits the active principle mixed with other substances. It is water-soluble, contains but a trace of protein but no lipid, is salt-free, and free from alcohol-soluble matter. Its physiological action has been worked out in some directions, but chemically next to nothing is known of its nature. Studies are, however, under way to isolate the active principle, and when this is done it will be identified chemically and synthesised artificially, just as has been done for adrenaline, the hormone of the suprarenal glands.

As yet it is too early to state whether insulin is

a cure for diabetes, but what is certain is that it alleviates the symptoms, enabling patients to partake of a relatively hearty meal, to put on weight, and to recover their mental and physical vigour. Its method of administration is not devoid of complications, the only effective way at present being hypodermic injections twice daily.

Fertilisers—A "Key" Industry

Under the heading "Fertilisers before and after the War" (reprinted from the Transactions of the Highland and Agricultural Society of Scotland, 1922) Prof. James Hendrick, of the University of Aberdeen, gives an interesting review of the present fertiliser position as compared with that obtaining before the war. The enormous growth in the production and consumption of the most important nitrogenous, potassic and phosphatic fertilisers during the years immediately preceding hostilities is illustrated by selected statistics, after which the radical alterations in the fertiliser position which were brought about owing to war conditions are briefly explained. The author rightly points out that the fertiliser industry is of just as much, if not more, importance to the country in time of war as the dyestuff and fine chemical industry, although it is almost exclusively the latter that has attracted attention in this connexion. Whereas the dyestuff industry can be adapted in time of war to the actual manufacture of munitions, it is the fertiliser industry which is the mainstay of the country for the production of the sulphuric acid, nitrates and ammonia, without which the munitions cannot be manufactured. The present position with regard to the production and the agricultural value of the three great classes of artificials is then dealt with in some detail, the relative value of the newer fertilisers of each class in comparison with the older ones being illustrated by the results of manurial trials carried out at the Craibstone Experimental Farm of the University of Aberdeen, and in other parts of N.-E. Scotland.

Propyl Alcohol as a Disinfectant

The best disinfectant for use on the skin is propyl alcohol because it is a strong germicide and harmless to the skin, even after extended use. Solutions of 35 to 50 per cent. strength have given good results with facial acne and various diseases of the hair, whilst poultices containing 10 to 20 per cent. solutions have often proved useful in treating bacterial eczema.—(*Pharm. Zentralh.*, No. 31, 1922.)

Fusel Oil and Acetone in Czechoslovakia

The annual output of fusel oil in Czechoslovakia is about 150, metric tons, of which 5 per cent. is consumed locally and the remainder exported, mainly to Germany, the United States, Holland, Austria, Hungary, and Switzerland. The whole output of fusel oil in the Succession States of Austria-Hungary is refined in one factory in Bohemia. Butyl alcohol, which competes with fusel oil in the United States, is not used in Czechoslovakia. Acetone, obtained from the dry distillation of beech wood, is produced by five factories, and of the total annual output of 600 t., about four-fifths is exported. About 3000 work-people find employment in the acetone industry and the question of fiscal protection is being considered. Acetone is used chiefly in making paints and related products, artificial and patent leathers, and celluloid articles. In Czechoslovakia the manu-

fracture of photographic films is negligible and that of artificial silk and cellulose acetate in its infancy. —(*U.S. Com. Rep.*, Sept. 11, 1922.)

New Deposit of Talc in Austria

Work has been commenced on the talc deposit recently discovered near Mautern, in Steiermark, Austria. The deposits are from 1 to 1·8 metres thick and about 2000 m. long.

The World's Production of Electric Iron and Steel

Prior to 1913 electric steel was produced almost exclusively in the United States and, especially, in Germany and France; although production began in 1908-9, it did not attain importance until 1913. Under the stimulus of war conditions, however, the world's production increased rapidly, reaching a maximum in 1918, as is shown by the following statistics:—

I.—Output of Electric Steel Ingots and Castings

	1913	1915	1916	1917	1918	1919	1920	1921
	Metric tons							
United States	30,663 ..	70,523 ..	171,621 ..	300,416 ..	519,546 ..	390,603 ..	510,186 ..	172,211 ..
Germany	88,881 ..	131,579 ..	190,036 ..	219,700 ..	240,037 ..	55,382 ..	— ..	— ..
Great Britain	— ..	22,352 ..	47,456 ..	100,169 ..	117,295 ..	78,232 ..	90,526 ..	27,534 ..
Canada	— ..	5,715 ..	17,813 ..	45,774 ..	108,051 ..	14,060 ..	25,669 ..	17,114 ..
Austria-Hungary	26,837 ..	23,895 ..	47,247 ..	47,152 ..	41,163 ..	— ..	— ..	— ..
France	21,124 ..	21,000 ..	44,429 ..	54,031 ..	58,222 ..	42,559 ..	58,080 ..	24,457 ..
Italy	— ..	26,946 ..	32,677 ..	47,744 ..	71,964 ..	88,824 ..	119,378 ..	140,000*
Sweden	2,276 ..	2,187 ..	6,648 ..	10,664 ..	13,089 ..	11,818 ..	12,356 ..	— ..

* Estimated.

After 1918, despite a temporary revival in 1920, production fell rapidly, except in Italy, reaching a low level in 1921, a year in which the German output was probably about 45,000 tons. Especially noteworthy was the increased production of electric steel castings and cast alloy steels in the United States, the respective figures being 935·4 t. and 450 t. in 1913, and 86,457 t. and 10,245 t. in 1921. The Italian industry has developed continuously, and at the end of 1921 there were about 50 works possessing 180 electric furnaces with a total capacity of about 800 tons. Most of the furnaces are of the Stassano type, and although Héroult and Girod furnaces are in use, they are gradually being replaced by Fiat and other Italian makes. The number of electric furnaces in Great Britain has increased from 21 (owned by 16 companies) with capacities ranging from 1 to 3·25 t. in 1914 to 150 with capacities varying from 0·25 t. to 20 t. in 1922. In 1921 the first electric furnace was installed in Ireland. An indication of the growing importance of electric furnaces in the steel industry is given by the increased output of electric steel castings in Great Britain, viz., from 3032 t. in 1915 to 16,967 t. in 1921. Similarly, in Canada the proportion of steel castings to total output of electric steel has risen from 43·6 per cent. in 1919 to 83·2 per cent. in 1921. Recent statistics for Germany are not available, but, owing to the loss of large areas under the Peace Treaty, it will be long before the country recovers its former importance as a producer.

Electric pig iron is made by reducing iron ores with coke or charcoal, and by preparing "synthetic" iron or re-melting steel scrap with cast iron; the former method is used in Sweden and Norway, the latter in France, Canada, and Italy.

II.—Output of Electric Pig Iron

	1913	1915	1916	1917	1918	1919	1920	1921
	Metric tons							
France	28,753 ..	29,760 ..	46,208 ..	90,309 ..	83,959 ..	55,422 ..	59,656 ..	— ..
Sweden	31,966 ..	35,075 ..	44,782 ..	67,059 ..	75,684 ..	64,470 ..	82,575 ..	— ..
Italy	4,160 ..	3,600 ..	16,911 ..	56,524 ..	61,888 ..	29,057 ..	— ..	— ..
Norway	— ..	8,742 ..	6,233 ..	6,295 ..	9,007 ..	2,032 ..	2,852 ..	— ..
Canada	— ..	— ..	— ..	12,418 ..	29,052 ..	6,985 ..	8,013 ..	— ..

The future of this branch of the iron and steel industry appears to be promising despite the reduced production in 1919; the production from five countries in 1921 is reported to be more than twice that of six countries in 1913. At the end of 1920 there were 15 completed blast furnaces (14 in Sweden, 1 in Japan); 15 were being built (4 in Sweden, 6 in Italy, 2 in Brazil, 3 in Norway); and all of them, except those in Italy and Japan, were designed for utilising charcoal as fuel. In 1920, out of a total production in Sweden of 82,575 t. of electric pig iron, 15,793 t. was made in hot-shaft furnaces, which resemble those used in making iron alloys and carbide. These furnaces were used because of the shortage of pig iron; they have a small capacity and much of the heat and all the valuable gases evolved are lost, so that their use is

only profitable in special circumstances. During the war many furnaces of this type were used for making "synthetic" iron in countries possessing hydro-electric power.—(*Stahl u. Eisen*, Oct., 1922.)

The Olive-Oil Industry in Italy and Tunis

Although Italy has a larger area planted to olive trees than any other country in the world, it only takes second rank as a producer, the output being about 26 per cent. of that of the world, compared with 37 per cent. from Spain. Production and exportation have recently been as follows:—

	Area	Production	Exportation
	Acres	Metric tons	
1913	4,315,584 ..	156,780 ..	22,340 ..
1919	4,248,400 ..	108,590 ..	1,090 ..
1920	4,226,170 ..	171,000 ..	1,236 ..

The large domestic consumption is the cause of the disproportion between production and exportation; thus, in 1913, when 22,340 t. was exported, 2086 t. of (crude) foreign olive oil and 13,462 t. of cottonseed oil had to be imported. Exports in 1921 were only 3199 t., and this failure to regain the pre-war level of exportation is due to decreased production, prohibition on imports of cottonseed oil, and the tendency of other countries to refine their own oil. Exports of sulphur oil, mainly to the United States and France, have risen from 8878 t. in 1913 to 10,821 t. in 1921.

Tunis takes fourth rank among producers of olive oil, and although the area under olive trees decreased from 889,560 acres in 1910 to 579,820 acres in 1918, the output of oil increased from an average of 22,217 t. during the period 1910-15 to 37,489 t. during the period 1916-20. War conditions stimulated the industry and exports rose from 13,067 t. in 1913 to 21,415 t. in 1919 and 23,287 t. in 1921, in which year the production was 70,000 tons. Tunisian oil is of little interest to the world's trade as the output is sold to France and Italy a year or more before it is produced.—(*U.S. Com. Rep.*, Sept. 25, 1922.)

An Italian Forerunner of Solvay

The process of making sodium carbonate by the interaction of salt and ammonium carbonate bears the name of Solvay, because, although not the first to discover the process, he was the first to apply it successfully on an industrial scale. The October issue of the *Giornale di Chimica Industriale ed Applicata* contains an article by Signor V. Ravizza on a predecessor of Solvay named A. G. Forni, who presented a project for manufacturing soda by the ammonia-soda process to the Austrian Viceroy in 1836, two years before Dyer and Hemming took out their patents and 25 years before the patent of E. Solvay. The project comprised a description of the plant required to produce 250 metric tons of anhydrous sodium carbonate per annum, and the erection of a small experimental plant in Milan was authorised by the Austrian Government. Nothing came of the trial, owing to the illness and financial troubles of the inventor, and after a commission of chemists had, on erroneous grounds, reported against the process, Government support was withdrawn. Efforts to obtain private assistance were also unsuccessful, and the only record now remaining is a descriptive pamphlet written by Forni in 1841.

REPORTS

REPORT ON THE COMMERCIAL, INDUSTRIAL AND FINANCIAL SITUATION IN JAPAN IN 1921 AND UP TO JUNE 30, 1922. By SIR E. T. F. CROWE, H.M. Commercial Counsellor, and G. B. SANSOM, Acting H.M. Commercial Secretary, Tokyo. Department of Overseas Trade. Pp. 59. H.M. Stationery Office, 1922. Price 1s. 6d.

The hope entertained early in 1921 that Japan was on the way to economic recovery was not realised; although production and stocks diminished, and the home demand was active, the general situation remained unfavourable. The value of the exports in 1921 fell from 1948 million yen to 1253 mill. yen, and that of the imports from 2336 mill. yen to 1614 mill. yen, so that the adverse trade balance decreased by 27 mill. yen to 361 mill. yen (average value of yen in 1921=2s. 2d.). Although the value of the exports in 1921 was nearly three times the annual average for the period 1909-1913, this increase was due almost entirely to progress in the silk industry, whose prosperity depends on "fashion" in the United States. Exports of porcelain, glassware, sugar, and matches declined, but a considerable trade was done in bottles and tumblers. Negotiations took place between the chief Japanese match manufacturers and the Diamond Match Co., U.S.A., with the object of forming a ring to control the eastern markets for matches. The fall in prices was the main cause of the smaller value of the imports, and large increases were shown only by cotton (30 per cent. of the total imports), woollen textiles, machinery, rubber, photographic materials, and scientific instruments. Great Britain is still far from having recovered her pre-eminence in the metal trade, the imports of iron and steel and tinplate originating as follows (per cent.):—United States 45, United Kingdom 17, Germany 15, China 10, Belgium 8, and India 5. Attempts to manufacture tinplate in Japan have failed, and the ironworks are said to be unable to work at a profit.

Of fertilisers, only 18,000 t. of nitrate was imported from Chile (121,000 t. in 1921), and phosphate was in small demand. The United Kingdom supplied only 12 per cent. of the imported ammonium sulphate, the bulk coming from the United States, and a small proportion from Germany. In the heavy chemical trade, the chief features were keen competition in soda ash and large imports of rosin. Caustic soda is now manufactured in Japan from soda ash. Germany has regained dominance in the dye market and supplied 4 mill. lb. in 1921, the United States coming next with 877,000 lb.; in this industry the Japanese cannot compete with Germany, and many of the companies floated during the boom have ceased operations. Owing to the Government being compelled to cut prices, there was a marked revival of demand for camphor. The Japanese spend large sums on photographic materials, and of the importations, plates are purchased mainly in Great Britain, and paper and films in the United States. Statistics of the import and export trade are appended:—

Imports:—	Long tons	Imports:—	Long tons
Sugar	300,629	Rubber, crude ..	21,323
Salt	190,004	Kerosene (galls.) ..	27,073,000
Leather	2,914	Glass (£)	692,220*
Paraffin wax ..	15,284		
Rosin	7,982		
Caustic soda, soda ash	44,710		
Coal-tar dyes ..	2,491		
Sodium nitrate ..	17,896		
Ammonium sulphate	77,962		
Paper pulp	38,727		
Phosphorus ores ..	208,963		
Coal	777,255		
Iron ore	568,785		
Iron, pig	223,551		
Lead	33,158		
Tin	3,307		
Nickel	2,244		

* Value; yen = 2s. 2d.

The output of minerals and metals in 1921 was as follows:—

Gold .. oz. troy	236,969	Chromite ore	Long tons	3,309
Platinum	231	Manganese ore ..	"	3,811
Silver	4,185,502	Arsenic	"	1,374
Copper .. Long tons	53,238	Arsenic ores ..	"	1,481
Lead	3,089	Phosphorus ores ..	"	20,348
Bismuth	0.7	Graphite	"	856
Tin	289	Lignite	"	24,035,550
Mercury	6	Asphalt	"	6,823
Zinc	10,211	Sulphur	"	33,539
Iron, pig	88,540	Sulphur ores ..	"	24,777
Iron-sulphide ore	92,404	Petroleum, crude ..	galls.	77,854,400

Compared with 1920, nearly every item shows a big decrease.

THE TRADE IN INDIAN MYROBALANS. *Imperial Institute. Indian Trade Inquiry. Reports on Cinchona Bark and Myrobalans.* London: John Murray, 1922. Price 4s. net.

Myrobalans, the dried fruits of species of *Terminalia*, mostly *Terminalia Chebula*, Retz, are one of the chief tanning materials produced and used in India and are also exported in large quantities. The collection of the fruits affords a valuable minor source of revenue and is so largely in the hands of a combination of Indian dealers that it is considered unlikely that European firms would be able to compete successfully. Usually the season's crop is sold by tender on the trees, but contracts over a period of several years are sometimes made, the buyers undertaking to collect and dry the nuts, which are then sent to the warehouses where they are sorted and cleaned before being packed for shipment.

Five varieties of myrobalans are recognised in commerce, named according to the district of origin, as follows:—"Bimlies," or "B's," from Bimilipatam, Madras; "Jubbelpores," or "J's," from Jubbulpore, in the Central Provinces; "Rajpores," "R's," from Kohlapur State; "Vingorlas," "V's," from Bombay forests; and "Coast Madras"; each variety being separated as a rule into No. 1 and No. 2 grades.* The grading of nuts is usually done carelessly and gives rise to complaint among buyers in the United Kingdom, but as a rise in the price of No. 1's reduces the demand and stimulates that for No. 2's, there is not much inducement to improve grading. It is recommended that all unsound nuts be removed before shipment. At the present time myrobalans are bought by tanners in this country largely on appearance, and although it would be preferable to sell on a basis of tannin content, and colour determination, it must be remembered that the value of myrobalans to the tanner depends not only on the high tannin content, but also on other properties, such as deposition of "bloom" on the leather, and fermentation with the production of acid necessary to swell the hide.

It has been largely supposed that the immature nuts are richest in tannin, but analyses of fruits of different stages of maturity made at the Imperial Institute and also by Puran Singh (*Indian Forester*, 1915, 41, 15) show that fully ripe fruit contains most tannin. Myrobalans alone do not form a satisfactory tanning material, but are most useful when blended with other materials; in sole-leather tannage quebracho with 25–30 per cent., mimosa bark with 15–20 per cent., or mangrove bark with up to 50 per cent. of myrobalans, are generally used.

Myrobalans are usually shipped to Europe as whole nuts, but recently increased quantities of crushed nuts (freed from stones) have been exported, and if improvements in crushing were introduced it is considered that the bulk of the demand would be for the crushed material. It appears that the crushed material is often packed wet, so that it becomes sticky and forms lumps which cannot be extracted, whilst many of the crushed fragments are also too large for easy extraction. The preparation in India of liquid or solid extracts for export does not appear to offer any advantages, as in neither case would the extract contain more tannin than the nuts. Considerable amounts of liquid extract are prepared in the United Kingdom.

Myrobalans, either in the form of fine powder or as extract, are also used in the dyeing industry, chiefly in the "heavy woollen district" of Yorkshire, where the cloth consists of "shoddy" with 50–70 per cent. of cotton. Myrobalans are used in conjunction with iron for dyeing the cotton black, but as the colour is not fast to acid, this method has been replaced to some extent by the use of Cotton Milling Black. In the Bradford trade the use of myrobalans for the production of black on cotton is declining owing to the superiority of Direct Dyeing Blacks, which permit the subsequent dyeing of the wool by acid colours. A small demand also exists for myrobalans in the indigo-dyeing industry, where it is employed to remove surplus dye from the fabric. The demand for myrobalans in dyeing is not likely to increase, but may be maintained, as they are cheaper than sumach (the only other available pyrogallol tanning material).

The importance of the trade in myrobalans is considerable. Prior to the war Indian exports amounted to about 1,400,000 cwt. annually, valued at nearly £400,000; of the 40–50 per cent. shipped to parts of the British Empire, almost all went to the United Kingdom; the remainder was taken chiefly by Germany (one-fifth of the total export), the United States (one-sixth), Belgium (one-ninth), and smaller quantities to France, Italy, Russia and Japan.

It is proposed to investigate, in India, the different varieties of *Terminalia*, and to carry out analyses and tanning trials in the Imperial Institute with fruits of the different varieties; and the Committee suggests that an inquiry be made into the methods of collection, drying, grading and storing myrobalans in India.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for November 23 and 30)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina ..	Metals, tinplate	619
Australia ..	Pottery, glassware	567
Belgium ..	Pharmaceutical and industrial chemicals	573
" ..	Special steel, aniline oil, cresylic acid, potassium and sodium bichromates, boric, carbolic and citric acids, benzine, benzol, bleaching powder, dyeing and tanning extracts, formaldehyde, nicotine, sulphites, bisulphites, petroleum jelly, pitch, potassium cyanide, soda	575
" ..	Rubber goods	597
Brazil ..	Paint, varnish, oils	591
British India ..	Metals, cement, soap, perfumery, paper, glassware	568
Canada ..	Pottery, perfumery	↑
" ..	Insulating porcelain and glassware ..	9908/E.D./E.C.
China ..	Asbestos roofing	617
Egypt ..	Drugs, medical stores (tender for) ..	9409 F.E./C.C.
" ..	Paper (tender for)	9483 F.E./M.P.
Latvia ..	Kerosene, asbestos sheet, varnish, chalk, ozokerite, pigments, tin (tender for)	6610 F.R.
Morocco ..	Leather, rubber	9357 F.E./G.C.
Norway ..	Oils, fats	606
Peru ..	Earthenware, lead sheets and pipes ..	593
South Africa ..	Disinfectant fluid (tender for) ..	10040/E.D./C.C.
Sweden ..	Chemicals used in tanneries and rubber factories	581
Switzerland ..	Technical and pharmaceutical chemicals	613
" ..	Leather	615
" ..	Oils, fats, chemicals, metals, alloys, tin, fertilisers	616
United States ..	Leather scrap	17639 F.W./M.P.

* For a comparison of the tanning properties of commercial grades of J., Parker and Blockey, 1903, 1181.

† Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

TARIFF CUSTOMS EXCISE

Austria.—Increased consumption taxes are payable on spirits, wine, sugar, matches, various beverages, acetic acid, and artificial sweetening substances. Export duties are leviable on raw hides and skins, horn, wood, ores, magnesite, rosin, turpentine, paper pulp, and rubber waste.

British Guiana.—Surtaxes of 10 per cent. of the specific duties are applied to goods included in the first schedule of the Customs Duties Ordinance, 1922, and of 20 per cent. to goods specified in the second schedule.

British India.—Regulations have been issued controlling the importation of preparations of morphia, opium and cocaine.

Canada.—Under a recent customs ruling silica, magnesia, and chrome firebricks are entitled to entry free of duty.

Denmark.—A modified scale of import duties has been applied to alcoholic beverages, ethers, perfumery and perfumed articles. Denatured spirit or spirit for medicinal use are exempted from the additional duty now payable on spirit of 50 per cent. strength.

Federated Malay States.—Draft rules have been issued providing for restrictions on the export of rubber.

France.—The commercial arrangement with Italy which was signed on November 13 came into force on November 28.

French Togoland.—New import tariffs have been fixed for spirits, alcoholic dyestuffs and perfumery, sugar, salt, and denatured alcohol; and new export tariffs for palm oil and kernels, copra, cotton and sisal. The duty-free list includes fertilisers, coal, bottles, and scientific products.

New Hebrides.—A recent regulation prohibits the import of pure alcohol, crude spirit, or any alcoholic liquids, but not of pure alcohol for industrial, pharmaceutical or medical use.

Nigeria.—Fuel oil for power purposes may be imported duty-free.

Poland.—Surtaxes have been applied to the customs duties on certain goods, as follows:—900 per cent.: certain fertilisers, graphite, antimony, nitric acid, certain edible oils, metals, cellulose and paper; 4900 per cent.: superphosphates, olein, asbestos, electrical carbons, silica and magnesite bricks, various wares of glass, certain coal-tar products, sulphur, rare-earth products, sodium bicarbonate, carbon bisulphide; 14,900 per cent.: ammonium nitrate, chloride of lime, sodium sulphite and hydrosulphite, acetate of lime, sulphuric ether, tanning extracts, etc.

Rumania.—Opium and its derivatives may be imported only by special authorisation.

San Thomé and Príncipe.—By a recent decree the export duties are doubled, as are also the import duties, except those on sugar, calcium carbide, olive oil, medicines, quinine salts, matches, and paraffin.

Sweden.—Export prohibitions have been withdrawn from gold, silver, and platinum.

Uganda.—The customs tariff now in force in Kenya has been applied to Uganda.

United States.—The rules of procedure under the "flexible-tariff" provisions of the new customs tariff are published in the issue for November 30.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Merchandise Marks Bill

Sir P. Lloyd-Greame, President of the Board of Trade, informed Mr. Hannon that this Bill could not be re-introduced before Christmas, and he was unable to state when such legislation would be considered.—(Nov. 27.)

Guarantees under the Trade Facilities Act

Answering Mr. Briggs, Mr. Baldwin, Chancellor of the Exchequer, said that the total amount guaranteed under the Trade Facilities Act up to September 30 was £23,563,645. The guarantees given since that date included £2,000,000 to the Newfoundland Products Corporation, Ltd., £50,000 to the Dolcoath Mine, Ltd., and £850,000 to the Tata Power Company.—(Nov. 27.)

Coal Output in Great Britain and the United States

In reply to Commander Bellairs, Mr. Lane-Fox stated that the output of coal per man in Great Britain was 257 tons in 1910, 144 t. in 1921 (when all pits were idle for 3 months), and 216 t. in the year ending September, 1922. In the United States the output per man (including that of anthracite) was 618 t. in 1910 and 549 t. in 1921. These figures were not strictly comparable as coal-mining was much easier in the United States than in this country.—(Nov. 27.)

Surplus Government Chemicals

Mr. Baldwin, in a written answer to Mr. Hancock, said that the Disposals Board had held sales of chemicals on other dates than September, 1920, but the preparation of statistics showing the results of such sales would be too expensive.—(Nov. 28.)

Charges for Tona Gas

In answer to Mr. Jephcott, Sir P. Lloyd-Greame said he had received requests for an inquiry into the present method of charging for town gas on a thermal basis, and had appointed a Departmental Committee of Inquiry consisting of Sir C. Hyde, Mr. A. Balfour, Sir J. Martin, Mr. A. A. Pugh, and Mr. W. J. U. Woolcock.—(Nov. 30.)

Petroleum Production

In reply to Mr. Hancock, Sir P. Lloyd-Greame said that the production of crude petroleum in 1921 in Great Britain, Trinidad, Egypt, and Mexico was 140,000 tons (estimate), 334,000 t., 190,000 t., and 28,000,000 t., respectively. The cost of production could not be stated.—(Dec. 4.)

"Reparation" Dyestuffs

Sir P. Lloyd-Greame, answering various questions, said that the appointment of the British Dyestuffs Corporation as distributing agent for "reparation" dyes had been approved by the Colour Users' Association and dye manufacturers other than the Corporation. The agreement was terminable at three months' notice on either side, and the commission payable to the Corporation was 6·5 per cent. on gross turnover, plus 1 per cent. for guaranteeing accounts. The commission was to cover charges for importation, packing, storage, etc., but the Board had agreed to make a maximum annual grant of £30,000 towards the cost of these charges. He was not aware that any information obtained by the

Corporation in the conduct of the agency was being utilised improperly.—(Dec. 4.)

Blast Furnaces

In a written answer to Major Kelley, Sir P. Lloyd-Greame stated that, at the end of October, 151 out of 487 furnaces were in blast in the United Kingdom, 109 out of 221 in France, and 33 out of 54 in Germany. Particulars for Germany could not be given.—(Dec. 4.)

Disposal Board

Mr. Baldwin informed Sir A. Hunter-Weston that the expenditure of the Disposal Board during the past year was £2,600,000, of which a large proportion was incurred in the destruction of poison-gas shell, breaking down ammunition, etc. The cost of maintenance of Gretna factory during the last year was £27,000, but revenue amounting to £20,000 had been received, and sales of plant since January 1 had realised £250,000, the sale expenses being 5 per cent. of the prices realised.—(Dec. 5.)

Feeding Stuffs and Fertilisers

In reply to Mr. Dixon, who asked whether the proposed departmental committee on the cost of agricultural produce to the consumer would also inquire into the cost of feeding stuffs and fertilisers, Sir R. Sanders, Minister of Agriculture, said that the terms of reference would be limited to questions relating to agricultural, horticultural and dairy produce and that the committee would have to decide what articles were included within the scope of the terms of reference.—(Dec. 5.)

British Empire Exhibition

In a written answer to Sir H. Holbrook, Sir W. Joynson-Hicks said that the President of the Board of Trade had invited him to investigate the use of materials and supplies of Empire origin in the British Empire Exhibition.—(Dec. 6.)

Home-Grown Sugar-Beet

Replying to Mr. A. Bennet, Sir R. Sanders wrote that an area of 3776 acres at Kelham and 4180 acres at Cantley, i.e., a total of 7956 acres, was planted with sugar-beet. Both crops were to be worked this season at the Cantley factory, which employs 600 men; the average weekly wage is about £2 11s. 8d.—(Dec. 6.)

Pasteurisation of Milk

Major Boyd-Carpenter, replying to Sir J. Leigh, said that there was some distrust of pasteurisation as now practised, partly on account of the high temperatures frequently employed commercially. There was no evidence that pasteurisation properly conducted would destroy the essential qualities or constituents of milk. It was hoped that the steps now being taken by the Ministry of Health would conduce to the provision of wholesome milk at reasonable prices.—(Dec. 7.)

Safeguarding of Industries Act

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Key Industries.—The Act has enabled the industries covered by Part I to continue, and to extend the range of production considerably. Returns are to be supplied showing the state of employment in these industries.—(Nov. 27.)

Receipts from Duty.—The amounts of duty collected under Part II, up to November 24, are

as follows:—Fabric gloves, £50,695; glassware, domestic, £995; glassware, illuminating, £3599; hollow-ware, domestic, £8370; incandescent gas mantles, £35. The date of the Order respecting gas mantles was October 9, and of that respecting the other goods August 8. The cost of collection has been less than the receipts.—(Nov. 27.)

Sodium Hyposulphite of photographic quality is well known to the trade, but there is no fixed standard to which it must conform; hyposulphite of this quality is dutiable.—(Dec. 4.)

Potassium Permanganate is not dutiable unless of "R" quality. If a claim for duty is disputed on the ground that the consignment is not of dutiable quality, the importer can apply to have the matter referred to a referee under Part II. of the Act.—(Dec. 4.)

Sulphocyanides.—The sulphocyanides of aluminium, barium, and copper were removed from the lists because the Referee's observations in the cream-of-tartar case indicated that he would probably regard these compounds as heavy chemicals. These observations do not apply to sodium and potassium sulphocyanide, and they were therefore left in the lists.—(Dec. 4.)

Scientific Instruments.—The report of the committee which investigated the application for a duty of 33½ per cent. on scientific instruments is being considered and an announcement will be made shortly.—(Dec. 4.)

Vulcanised Fibre.—The report of the committee appointed to consider the complaint regarding the dumping of vulcanised fibre from the United States is unfavourable to the complainants and will be published and presented to Parliament at an early date.—(Dec. 4.)

Duties.—The total amount collected in duties under the Act, up to and including December 1, 1922, is £432,575.—(Dec. 7.)

During the debate on the motion for an Address in reply to the King's Speech, Sir J. Simon moved an amendment, regretting that no mention was made in the Speech of the repeal of the Safeguarding of Industries Act and other protective measures which were raising prices, hampering trade and limiting employment. Sir J. Simon discussed the administration of the Dyestuffs Act and observed that this and similar measures tended to restrict the free rights of British merchants to purchase in the best market. The licensing system under the Dyestuffs Act implied selection and therefore favouritism, and exporters were unable to know whether they could safely accept repeat orders. It was right to protect a "munitions industry," but the worst way to do so was to enable selected manufacturers to make additional profits out of their fellow-subjects. The duties under the Safeguarding of Industries Act had been imposed on 6300 chemicals instead of on a few directly connected with military preparedness. Imported chemicals were being detained at the ports to ascertain whether their purity made them dutiable. It was claimed that, as a result of the Act, 2000 fine chemicals were now being made in this country, but the highest chemical authority stated that the list consisted very largely of impure German chemicals that had been purified in this country.

In reply, Sir P. Lloyd-Greame observed that when the war began we lacked optical glass, drugs, and

chemicals of every kind, and Lord Balfour of Burleigh's Committee had recommended that those key industries should be protected, as an essential assurance against war. To-day, optical-glass factories were being steadily developed, many new chemical factories were being started, the range of production was growing, and so excellent were our scientific instruments that scientific institutions in France, Belgium and Italy bought them in preference to cheaper foreign products. Prices of optical glass had fallen by from 20 to 50 per cent. and of chemicals by from 20 to 30 per cent., and if the consumer did not always benefit, that was the fault, not of the Act, but of the middleman. It had been arranged that the Board of Trade and the Department of Scientific and Industrial Research should investigate the key industries to ascertain what progress had been, and was being, made. The legislation against dumping and unfair competition was promised during the war, and it would be unwise to repeal it just when the United States had set up a prohibitive tariff that would probably lead to dumping in this country. The principle upon which the Act and the duty levied under it were based had been accepted by each successive Government, and he asked the House not to reject it.

Sir A. Mond said that the disappearance of key industries might put the country in a serious position, but it was never anticipated that the Schedules to the Act should be extended or applied in the way they had been, and he believed the administration of the Act required revision. The attempt was being made to establish the dyestuffs industry—one of the most difficult in the world—in face of able competitors who had 40 or 50 years' experience, and free competition would make the task almost impossible. The progress made was disappointing and should be investigated. Mr. G. C. Clayton, in opposing the motion, recalled the history of tungsten manufacture in this country and of the German monopoly of supply prior to the war. Without the present Act, manufacture of tungsten at Widnes would now have to cease. Mr. Asquith remarked that the Act was a farce; there was no evidence of any dumping now; and the remedy was worse than the disease. Lt.-Com. Astbury gave instances to show how German makers reduced the prices of certain dyes when British makers began to produce them, and pointed out that if the Dyestuffs Act were repealed, Germany would force every British maker to close within six months. British dye-makers had produced 500 new colours, 516 colours equivalent to German colours, 28 vat colours (made for the first time in this country), and 82 research chemicals. It was pointed out by Mr. H. Spencer that the price of the commonest Swiss dye was one-half that of the British equivalent, and that British dyers still refused to guarantee the fastness or wearing qualities of their products. It was true that the cost of dye represented a small fraction of the total cost of the textile, but that small fraction was sufficient to make competition with foreign makers impossible. Sir R. Horne said that the duty of 33½ per cent. applied under Part II. was intended, not to stabilise the exchange, but to give at least some help in adjusting the difference between the internal and the external purchasing value of the foreign currency. The amendment was defeated by 269 votes to 207.—(Dec. 4.)

REVIEWS

THEORIES OF ORGANIC CHEMISTRY. By DR. F. HENRICH. *Translated and revised from the 4th German edition by PROF. T. B. JOHNSON and PROF. DOROTHY A. HAIN. Pp. xvi+603. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922. Price 30s. net.*

Many English readers who are familiar with the German edition of this work will probably agree with the reviewer that its chief defect is the tendency to omit reference to work carried on outside Germany. The translators of the book appear to have been aware of this defect, and they are quite frank concerning the treatment of it, for in the preface it is stated that "in presenting the work to an American public it has seemed desirable to stress wherever possible the contributions of American investigators." In pursuing this plan the translators have improved the original work. Thus the section on electronic conception of valency has been rewritten and now includes a new chapter containing an account of the theories of Falk and Nelson, Lewis, and Fry; but this account will hardly attract the full interest of British readers, since the work of Langmuir has been omitted with the notable developments made by Lapworth, Robinson and other English research workers. Another welcome addition is the chapter dealing with Nef's theories, and in the reviewer's opinion the translators have done wisely in reproducing the original paper in which these were summarised. The account of intramolecular rearrangement has been greatly improved by revision and by the addition of the researches of Stieglitz and of Wheeler and Johnson, which received very brief notice in the original. These are the chief additions, but other changes have been made in the order of treatment, with the result that the logical sequence of the subject is improved; for example, an account of pseudo-acids and bases is now given immediately following that of tautomerism.

These alterations have undoubtedly enhanced the value of the book, but it is unfortunate that the translators did not carry out their revision on a broader basis. The reader will notice that no reference is made to the work of Thorpe and his collaborators on the glutaric acids, ring-chain tautomerism and the stability of spirane systems. In the chapter dealing with rotatory power and constitution the researches of Pickard and Kenyon, Lowry and others are omitted, and the work of English investigators on the relation of absorption of light to constitution is hardly noticed. An account of recent research in stereochemistry is wanting, and in the reviewer's opinion a few pages devoted to the work on molecular asymmetry would have been a useful addition. In further criticism it may be added that some subjects seem to be unduly stressed, particularly the description of Stark's hypotheses and the work of Hantzsch on chromoisomerism. Beyond these remarks there appears to the reviewer little to be said by way of criticism, whilst in praise of the book much could be said; it will undoubtedly receive a wide welcome.

The work of translation has been well done; the style is clear and in a book of this kind, which contains so many complex formulæ, it is surprising to meet with so few errors in the text. One of the chief purposes of the translators is to increase the

research worker's knowledge of the history of the science and his appreciation of the work of its founders. These valuable advantages, together with a more correct perspective of modern work, are, in the reviewer's experience, to be gained by reading some book such as Graebe's History of Organic Chemistry before the study of the present volume is undertaken.

SAMUEL SMILES.

CRITICAL SURVEY OF QUESTIONS AFFECTING THE COKE-OVEN INDUSTRY. By DR. CARL STILL. *Translated from the German by Coke and Gas Ovens, Ltd., Salisbury House, London Wall, E.C.2, and published by permission of Glückauf. Pp. 137—300.*

The survey is an excellent translation of various articles from *Glückauf* by Dr. Carl Still, now published in a convenient and compact form. The work is divided into three sections dealing with (1) Benzol Recovery, (2) Design of Coke-Oven Flues, and (3) Manufacture of Sulphate of Ammonia, respectively. Each branch is treated exhaustively from a purely theoretical standpoint and the author has gone to considerable pains in a praiseworthy effort to apply the laws underlying physical phenomena to the numerous problems met with in the designing and practical operation of modern coke-oven plants. The work abounds in formulæ and equations, some of which are of a complicated nature and demand a mathematical knowledge beyond the powers of many associated with the routine of a coke plant. This, however, does not detract from the value of the work, as the necessary data, having been collected from well-known authorities, have the merit of authenticity. Moreover, and (in the mind of the writer) of supreme importance, the conclusions arrived at are in the majority of cases in remarkably close accord with the result of the writer's practical experience. To quote an example: the author condemns the common practice of endeavouring to obtain from a benzolised wash oil a crude product rich in benzol, giving, say, 65 per cent. distillate at 120° C., instead of aiming at the recovery of the whole of the absorbable hydrocarbons, whatever their nature may be, even if by so doing the distillation test be reduced considerably. In the case of a "rich" crude benzol, the author's theories point to a less in absorption efficiency and an actual loss of benzol. During the war period the writer had occasion to investigate this point, and has now ample proof from tests on a commercial scale that at the plant under observation the manufacture of a "straight" 65 per cent. product entailed a serious loss of hydrocarbons, including toluol, and only by effectively stripping the wash oil with a consequent product of less than 50 per cent. was the toluol recovered efficiently. The concordance of practice with theory in this case gives one confidence in the theories expounded, and on the whole, where the details of the equations are obscure they may be safely "taken as read" and the mind concentrated on the summaries and conclusions arrived at.

In section (1) the author discusses the determination of vapour tension, general rules for benzol absorption, internal conditions in scrubbers, benzol yields, effect of re-circulation of wash oil, etc., terminating this section with a *résumé* of the highest possible significance to workers in this

particular branch. In the second section the author deals with the design of coke-oven flues, going very fully into the question of the relative areas and sections of individual flues in ovens of the vertical-flue type, sizes of gas-nozzles, effect of varying widths of ovens, taper of ovens, etc. The points raised should be of great value in plants where the general construction allows of reasonable adjustment of the details of control. In section (3) the manufacture of sulphate of ammonia is discussed from the point of view of the more recent hot and cold, or, as commonly described, the direct and semi-direct, processes for the recovery of ammonia. The thermal aspect under varying conditions is treated fully and useful tables and charts are included. The writer has been highly interested in the work and can wholeheartedly recommend it as worthy of very serious consideration by all workers in the coke-oven industry.

J. E. CHRISTOPHER.

AMERICAN FUELS. By R. F. BACON and W. A. HAMOR. Vol. I, pp. ix+628; Vol. II, pp. vi+629. London: McGraw-Hill Publishing Co., Ltd., 1922. Price 60s. net.

These two volumes are inscribed as being of the Mellon Institute Technochemical Series. They consist of a series of twenty-six essays, by various authors, on different problems of fuel technology. As is perhaps inevitable with such a compilation, the arrangement of the material is not always happy; for example, some of the problems relating to power production are described under "coal preparation," and those relating to coal-washing under "finely-divided fuel."

Whilst the work no doubt makes a fairly complete survey of modern American practice, there appears to be a bias in favour of untried processes, which may or may not be still in the early experimental stage; and it is often difficult to judge whether the essayists describing these processes take them seriously or regard them as means of brightening their narratives. Some of the novelties described, with such details as are available, or the imagination of their inventors has anticipated, are such methods of cleaning coal as the Trent amalgam process, the Chance sand-flotation process, and electrostatic separation; a rotary gas-producer employing a pulverised fuel; the Dayton process for making producer gas from liquid fuel; and a mercury-vapour turbine, destined to rival the Diesel engine as a prime-mover; such things make interesting light reading.

Undoubtedly the most important article in the volumes is that dealing with the preparation and uses of pulverised coal; it is a long article (242 pages), and presents what is probably the best coherent account that has yet been published of this rapidly developing branch of fuel technology. Another commendable chapter is that on surface combustion, which as an industrial heating process seems to have had better luck in America than in this country. The remaining chapters are, as a whole, devoid of interest, though there are occasionally to be found, amongst the welter of commonplace, items of information regarding American thought and practice which have not been impressed hitherto upon British readers; it is, however, somewhat surprising, in view of the rapid development of fuel technology in America,

often to find adherence to antiquated and incorrect views of the phenomena involved in the preparation and use of the various fuels. No chemist can feel satisfied with the present extent of the application of scientific knowledge to fuel problems as exemplified in writings of this character.

The work is furnished with one inadequate index, annoyingly placed at the end of the second volume.

R. V. WHEELER.

ELECTRICITY. By S. G. STARLING. *Science in the Service of Man Series.* Pp. 245. London: Longmans, Green and Co., 1922. Price 10s. 6d. net.

Within the limited compass of about 240 pages the author of this book has endeavoured to cover the whole range of electrical engineering and the modern theory of electricity, and the result is that everything has had to be severely clipped, mathematics is entirely omitted, explanations are somewhat vague, and certain essential details are absent.

The first nine chapters are treated in the conventional way, and it is not until Chapter X is reached that real interest is stimulated; from here onward the author has done real service in putting modern theory in a simple and understandable form to those who have an elementary knowledge of the subject. Such defects as occur in this part of the book are due more to the author's desire to seek a simple and concise explanation of a difficult point without the aid of mathematics, than to a want of familiarity with the subject; had these chapters been expanded and made to cover the whole range of the preceding ones, even at the expense of eliminating such old friends as rubbed amber, loadstones, etc., which are to be found in scores of similar books, a real advance would have been made. As it is, we fear that the average chemist will find very little to interest him in the first part of the book, whilst those parts dealing with the strictly electrical-engineering problems are decidedly weak.

The treatment of the direct-current dynamo and motor and the description of the three-wire system of distribution are unsatisfactory. For the measurement of power the Kelvin watt-balance is described rather than the more simple and generally employed dynamometer-wattmeter of the two-coil type, and the Thomson energy-meter is the only type described, no reference being made to ampere-hour meters either of the magneto-motor or electrolytic type, although these are now almost universal on DC supply. The chapter on alternating currents is still more unsatisfactory. The author studiously avoids dealing with the effect of inductance and capacity in the AC circuit, with the result that from the outset he is in difficulty. The reader is left with the impression that resistance is the controlling factor in transformer windings, that single-phase generation is the rule rather than the exception, and that the single-phase induction motor is in most general use. How the latter machine is constructed, and how the split-phase necessary for starting is derived are left to imagination.

Polyphase currents are considered outside the scope of the book, and are therefore dismissed in a few words. We wonder what the power engineer will think of the statement on page 67:—"For these reasons the synchronous motor is no use for supplying power, and is only employed in certain smaller pieces of apparatus where constancy of speed is of the greatest importance."

In the chapter on electric lighting undue prominence has been given to subjects which have been written up so many times before. The carbon-filament lamp and the open carbon-arc occupy a large amount of the space which might well have been devoted to the more modern developments of electric illuminants. More on the processes of producing wire-filaments, the process of "dark or chemical" exhaust with the employment of "getters and fillers," metallic arcs, mixed electrode arcs, and vacuum-tube lighting would have been welcome.

The treatment of electrolysis and batteries is very elementary, and to the general reader will probably be of interest, but to the chemist a much fuller treatment would be more welcome. A brief description is given of the Nodon valve, now practically obsolete, but no mention is made of the more efficient mercury-arc-rectifier.

The chapters on Electromagnetic Theory and Wireless Telegraphy, Gases and X-rays, and Radioactivity are well done so far as they go, but they might have been expanded. The book concludes with a glossary of electrical terms, and here again we experience disappointment. The definitions of the ampère, ohm, and volt will not prove very helpful to the general reader, and the same applies to several of the other definitions.

In conclusion, it may be said that where the author has to deal with the purely physical problem the book is useful, but those parts dealing with the technical and engineering side of the subject require considerable revision; and the value of the work would be greatly enhanced by the inclusion of such subjects as the modern theory of magnetism, magnetic alloys, arc welding, electric furnaces, thermo-electricity and the electrical methods of measuring high temperatures, and the more recent developments in electric lighting.

CORRESPONDENCE

THE NEW COLOUR INDEX

Sir,—I appreciated greatly the review and constructive criticism of the Colour Index by Prof. H. E. Fierz in the last issue of the *Journal*, and am indebted to him for drawing attention to some errors and omissions. The fact that the Colour Index is published in parts affords the opportunity of incorporating such information in the list of corrections and additions in the final part.

The nucleus of the Colour Index represents mainly a collection of information on dyestuffs which has been published up to the present. This is then submitted to colour manufacturers and to members of the Revision Committee, and, as a result, numerous corrections have been made and additional facts have been included in the Colour Index as published. Unfortunately colour manufacturers are not always prepared to correct an inaccurate statement, as is shown in the case of Erio Azurine B (No. 59) quoted by Prof. Fierz, for Messrs. Geigy and Co. had an opportunity to make the correction but did not do so.

As Prof. Fierz states, absolute accuracy in a work of this kind is impossible for numerous reasons; the Colour Index represents an attempt to make the best use of the information at my disposal.

The desirability of including references to "Friedländer" was considered, and these refer-

ences were omitted because almost every German Patent quoted is contained in "Friedländer" and, consequently, can be found readily. It is intended to index, not only all the commercial names of dyes in the Colour Index, but also all the patent numbers quoted. The inclusion of a column in this patent index giving references to "Friedländer" is under consideration and, if decided upon, will meet Prof. Fierz's point.

Parts I, II and III of the Colour Index have now been published, and it is anticipated that the remaining parts will appear at monthly intervals until completion.—I am, Sir, etc.,

F. M. ROWE,
Editor, Colour Index.
Manchester,
Dec. 2, 1922.

OBITUARY

H. J. POWELL

The death of Mr. Harry James Powell, C.B.E., B.A., removes from the glass industry a prominent and well-known figure, and one who did much, over a long period of years, to maintain contact between science and industry.

The glassworks at Whitefriars are the oldest and most famous in London, the business having been commenced about 1680, coming to the Powell family in 1834. Mr. Harry Powell, after a training at Rugby and Trinity College, Cambridge, where he took a second class in Classical Moderations, entered the business in 1873, and throughout the long period of his control showed himself in sympathy with progressive ideas in the industry. Thus, in 1875, de la Bastie carried out experiments at the works on glass-toughening, whilst in that same year glasses were melted at the works containing salts of didymium and erbium for experiments to be conducted at Oxford.

This service to science was but the forerunner of many. Thus, Mr. Powell had vacuum vessels made for Prof. Sir James Dewar's low-temperature work in 1895; in 1897, special glasses for Lord Berkeley's experiments on electrolysis, and glasses for Professors Gray and Dobbie for use in investigations on the relation between the dielectric constant and the composition of glass. Commencing in 1911 a series of glasses was made to assist Sir William Crookes in his researches on glasses affording protection from heat and ultra-violet radiations. Under Mr. Powell's management of the works there were also produced, at various dates during the period of 25 years before the war, X-ray bulbs, glasses for artificial eyes, and special glasses for thermometers of very small depression constant. Technical investigations of special interest to the glass manufacturer were also carried out and were briefly summarised by Mr. Powell in a paper to the Society of Glass Technology in 1918. Because of his wide experience, as well as the ability of the factory to make a variety of scientific glass, Mr. Powell's services were of great value during the war period.

Mr. Powell was Juror for glass at the Paris Exhibition in 1889, one of the first vice-presidents of the Society of Glass Technology, chief contributor to the article "Glass" in the Encyclopædia Britannica, joint author with Messrs. Chance and Harris in 1882 of "Principles of Glassmaking," and the

author of a number of papers on glass technology. He also took an interest in public work before the war, representing Dulwich in the first and second London County Councils, was a governor of Dulwich College from 1898, a co-opted member of the London Technical Education Board, and a member of the Board of Education Committee for Advice on Art Education.

W. E. S. TURNER.

PUBLICATIONS RECEIVED

FLAVOURING MATERIALS: NATURAL AND SYNTHETIC. By A. CLARKE. *Orford Technical Publications*. Pp. 166. London: Henry Frowde and Hodder and Stoughton, 1922. Price 8s. 6d.

OXIDATIONS AND REDUCTIONS IN THE ANIMAL BODY. By DR. H. D. DAKIN. *Monographs on Biochemistry*. Second edition. Pp. 176. London: Longmans, Green and Co., 1922. Price 6s.

TABLES ANNUELLES DE CONSTANTES ET DONNÉES NUMÉRIQUES DE CHIMIE, DE PHYSIQUE, ET DE TECHNOLOGIE. *Published under the auspices of the International Union for Pure and Applied Chemistry*. Vol. II. 1913, 1914, 1915, 1916. Part I. Pp. 626. Part II. Pp. 627—1377. Paris: Gauthier-Villars et Cie.; London: Cambridge University Press; Chicago: University of Chicago Press, 1921.

GASWORKS RECORDERS. By DR. L. LEVY. Pp. 246. London: Benn Brothers, Ltd., 1922. Price 35s.

TECHNOLOGIC PAPERS OF THE UNITED STATES BUREAU OF STANDARDS. *Department of Commerce*. Washington: Government Printing Office, 1922:—

TENSILE PROPERTIES OF SOME STRUCTURAL ALLOY STEELS AT HIGH TEMPERATURES. By H. J. FRENCH. No. 205. Price 5 cents.

EFFECT OF HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF 1 PER CENT. CARBON STEEL. By H. J. FRENCH and W. G. JOHNSON. No. 206. Price 15 cents.

WEIGHING BY SUBSTITUTION. By C. A. BRIGGS and E. D. GORDON. No. 208. Price 5 cents.

THERMAL STRESSES IN CHILLED IRON CAR WHEELS. By G. K. BURGESS and R. W. WOODWARD. No. 209. Price 5 cents.

THE REDWOOD VISCOMETER. By W. H. HERSHEL. No. 210. Price 10 cents.

PUBLICATIONS OF THE UNITED STATES BUREAU OF MINES. *Department of the Interior*. Washington: Government Printing Office, 1922:—

INCLUSIONS IN ALUMINIUM-ALLOY SAND CASTINGS. By R. J. ANDERSON. *Technical Paper* 290. Price 10 cents.

EXPERIMENTAL PRODUCTION OF ALLOY STEELS. By H. W. GILLET and E. L. MACK. *Bulletin* 199. Price 15 cents.

TESTS OF GAS MASKS AND RESPIRATORS FOR PROTECTION FROM LOCOMOTIVE SMOKE IN RAILROAD TUNNELS, WITH ANALYSES OF TUNNEL ATMOSPHERES. By A. C. FIELDNER, S. H. KATZ and S. P. KINNEY. *Technical Paper* 292. Price 10 cents.

CORROSION UNDER OIL FILMS, WITH SPECIAL REFERENCE TO THE CAUSE AND PREVENTION OF THE AFTER-CORROSION OF FIREARMS. By W. J. HUFF. *Technical Paper* 188. Price 5 cents.

REVIEW

Vol. XLI]

DECEMBER 30, 1922

[No. 24

THE ARTIFICIAL SEASONING OF WOOD BY THE OZONE PROCESS

ALEX. RULE

M. OTTO, the inventor of the well-known Otto process for the sterilisation of water by means of ozonised air has introduced a process which makes use of the same agent for the artificial seasoning of wood on an industrial scale (British patents 125,846 and 133,263).

The object of this process is to obtain a material possessing all the characteristics of wood which has been dried and seasoned by the natural method. Natural seasoning proceeds very slowly and, in extreme cases, must be allowed to extend over several years, whereas the Otto process produces similar results within a few weeks. In freshly cut wood the cells are filled with sap consisting chiefly of water, which constitutes about 40 per cent. of the total weight of the wood; but, in addition, the sap contains a large number of complex substances, which may be classified into two main groups:—(1) Amylaceous substances, closely resembling starch in composition. (2) Resinifiable substances. In natural seasoning the wood gradually loses water, the starchy substances are converted into sugars and the resinifiable substances undergo oxidation to form solids. Only the ligneous tissue of the wood remains unaltered. These changes are accompanied by gradual alteration in external form; the wood shrinks, and, if the seasoning process is irregular, distortion may also occur—for example, a flat surface may gradually become curved.

The disadvantages of using incompletely seasoned wood in the various arts are too well known to need recapitulation; if these disadvantages are to be avoided care must be taken only to employ wood which has reached a condition of stability as a result of the complete oxidation of certain components of the cell-sap. This condition can only be attained with extreme slowness, as illustrated by the fact that wood, which has been exposed to the action of air for three years, still contains unchanged starch and unoxidised resinous matter. In certain industries, for example, the

manufacture of pianos, it is not at all unusual to leave the wood to season in the air for at least ten years before use. Wood left to season in this manner naturally represents capital lying idle and entails charges for storage-space, etc., most of which may be avoided by adopting a suitable process of artificial seasoning. At the present time the question of increasing the rate of seasoning is particularly important owing to the fact that, during the war, the existing stocks of seasoned wood were consumed almost completely: well-seasoned timber is therefore scarce and in many cases shortage of capital renders it practically impossible to continue to rely on the natural method in building up new stocks.

Several processes of artificial seasoning exist already, but according to M. Otto, none of these produces a material which possesses the same characteristics as naturally-seasoned wood. To reduce the moisture-content of wood to 10 per cent. by treating it with hot air, is a comparatively simple process; at the same time very few of the plants used for this purpose are really efficient. Wood, after treatment in this way, is certainly dry, but if the temperature in the drying plant does not exceed 60°C., all the above-mentioned components of the sap remain in the cells unchanged; subsequently certain of these components undergo slow oxidation, which is accompanied by contraction in the contents of the cells; as a result the wood gradually shrinks, just as it would have done if it had been employed in the green state. The starch, which still remains unaltered in the cells, attracts parasites and gives rise to the formation of mould; moreover, these unchanged components of the cell-sap are distinctly hygroscopic, consequently the wood absorbs moisture again from the air. If the temperature of drying is raised with the object of decomposing these substances the results are not very greatly superior. It is true that in these conditions the organic components of the sap are destroyed and disappear, but the general effect is to leave the cells empty, thus rendering the wood brittle and lifeless.

Other processes consist in removing the sap, previous to drying, by treating the wood with hot water or steam. In this way it is, indeed, possible to eliminate the organic components of the sap and to ensure that after the wood has once been dried it will remain so, but again, the cells are left empty and the wood possesses the same defects as arise from drying at a high temperature.

process on an industrial scale. It consists essentially in submitting the wood to the combined action of gentle heat and ozone, which brings about simultaneous evaporation of water and oxidation of the organic components of the cell sap. Two forms of apparatus, namely, compartment kilns and progressive kilns are employed. The latter form is illustrated by Figs. 1, 2, and 3.

Fig. 1.

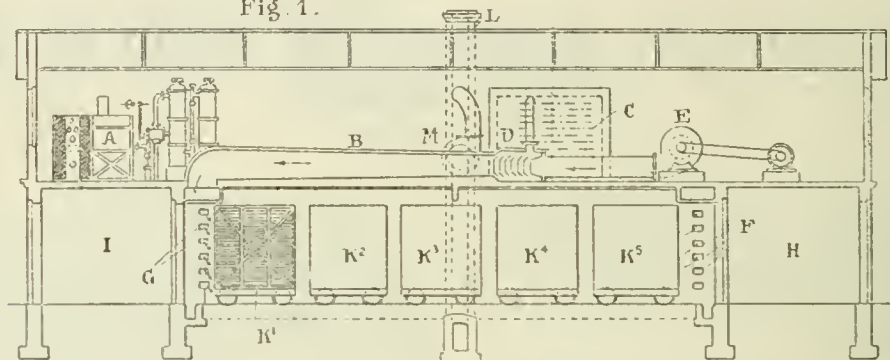
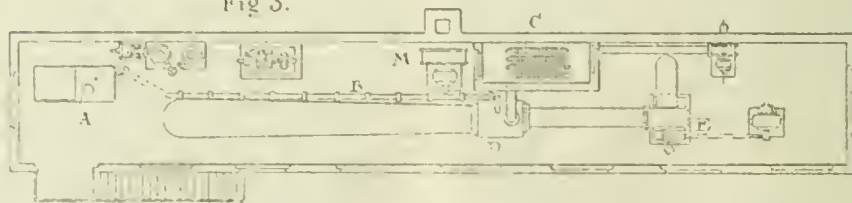


Fig. 2.



Fig. 3.



As a matter of fact no process is capable of producing the same results as natural seasoning unless it provides for the oxidation, without elimination, of the organic components of the cell-sap. If an artificial oxidising agent is employed for this purpose it must act rapidly, it must penetrate to the innermost portions of the wood without affecting the ligneous tissue, diluting the sap, or discolouring the wood, and it must leave no residue. These conditions prohibit the use of the majority of oxidising agents ordinarily employed in chemical industry; ozone, on the other hand, fulfils all these conditions and, as employed in the Otto process, is capable of reproducing exactly the phenomena and results of seasoning by exposure to air, but at a rate about three hundred times more rapid.

After a long course of experimental work on the subject M. Otto has now established his

A is an ozone generator of the type employed in the Otto process for sterilising water. The electrodes consist of cast-iron plates, which are cooled by a current of air and are separated by glass di-electrics. The air entering the ozoniser is dried beforehand in earthenware columns containing calcium chloride. B is a duct for circulating the ozonised air, C a heat generator, D an emulsifying mixer, which intermixes hot-air and ozone and consists of a series of conical nozzles suitably arranged (Fig. 1). E is a fan for producing circulation of the air. F, G are distributing ports, H and I hot-air locks at the entrance and exit respectively of the kiln, and K¹, K², K³, K⁴, K⁵ are the wagons for containing the wood.

After normal operation has been established the wood is submitted successively to the action of hot air, of ozonised air alone, and of a mixture of ozonised air and hot air. The duration of

treatment varies from ten to fifteen days, according to the nature of the wood. In that period green wood can be converted into seasoned wood possessing all the characteristics of wood which has been exposed to the action of air for ten years; the physical properties are identical, and no differences are detectable by the mechanical, chemical or microscopical tests usually employed to distinguish between naturally-seasoned and stove-dried wood.

The Otto process has undergone a thorough series of trials extending over two years, at the experimental factory in Paris, with perfectly satisfactory results. The "Conservatoire National des Arts et Métiers" has examined the process in its experimental laboratory and fully confirms the results claimed by the inventor.

In France the process is exploited by "La Compagnie Française des Bois," which possesses a factory at Paris containing two compartment-kilns, each with a capacity of 240 cubic metres. A new factory is being erected at St. Denis to operate the process in progressive kilns similar to that illustrated above.

THE EXTRACTION OF GASOLINE FROM NATURAL GAS

GEORGE A. BURRELL

Part II.—Extraction with Charcoal, and Plant Design

The third method used for extracting gasoline from natural gas is based upon the adsorptive power of "activated" charcoal. This process was perfected within the last four years by the writer and his associates.

A very porous charcoal was developed during the war for use in gas-masks. It was introduced by English chemists and first appeared on the battlefield in the form of the well-known box respirator of the English armies. Its method of preparation and mode of action have been widely discussed elsewhere, so that it must suffice here to say that the best activated charcoal for absorbing gasoline, and probably for most other absorption purposes, is made by first charring coconut shells at a moderate temperature, grinding the charcoal thus produced, and activating it (freeing it from residual hydrocarbons and other substances) by heating it at a high temperature in the presence of an oxidiser, usually steam.

In gasoline practice the activated charcoal, of 8—14 mesh, is placed in three absorbers, which, for a plant producing 1000 galls. of gasoline per day, are about 6 ft. high and 5 ft. in diameter. The natural gas is passed through one of the absorbers, and when the charcoal in it has become saturated with gasoline up to about 15 per cent. of its weight, the gas is passed into the second absorber; and then into the third. In the meantime saturated steam is turned directly into the first absorber to drive the gasoline out of the charcoal. The gasoline vapour and steam pass out of the absorber and through water-cooled coils, where they are condensed and separated. At any given moment one absorber is absorbing gasoline, one is being treated

with steam, and one is cooling. The residual gas is passed through the absorber being cooled in order to hasten this operation.

One advantage which the charcoal process has over other processes is that at very low pressures, 2—5 lb. per sq. in., the absorbent action of the charcoal is very efficient. At these pressures an oil plant requires very much more oil than is needed to treat the same quantity of gas at high pressures.

Five charcoal plants are now in operation and two more are being built.

DESIGNING GASOLINE PLANTS

In constructing a gasoline plant it is necessary that the quantity and quality of the natural gas be carefully determined. This is simple in the case of absorption plants built to treat natural gas at one of the main lines of a natural-gas company. Tests are usually made by means of a small portable absorber filled with absorbent oil. The gas is measured, and at the end of the absorption the gasoline is distilled from the oil with steam and measured again. Varying types of small absorbers are used. One built of pipe and coils on the principle of a Friedrich wash-bottle gives good results owing to the long contact between the gas and oil, and the best results are obtained with two or three of these absorbers placed in series. The gasoline content of natural gas may be deduced roughly from its density, and also by shaking a measured volume of it with the absorbent oil in a Hempel or similar pipette.

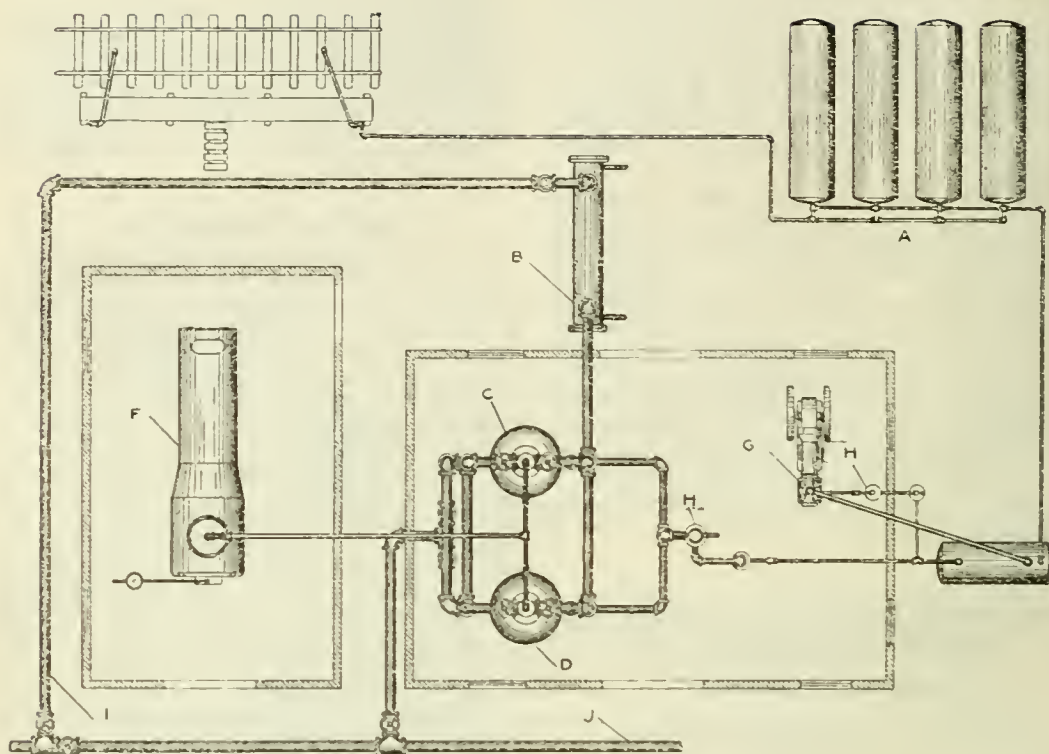
Casing-head natural gas is frequently tested by actually compressing and cooling the gas, as it comes from the well, in a small portable compressor, frequently mounted on a motor car and belted to its engine. Tests have also been made by passing the gas through a small coil embedded in a mixture of solid carbon-dioxide and acetone. Another method is to pass the gas through tubes containing charcoal, and to distil the gasoline from the charcoal by heating it in a distillation-flask about one-half filled with glycerin. There is a host of different testing methods, but these whereby the gasoline-content is directly determined with a small oil-absorber, a portable compressor, charcoal, or a freezing mixture, are the more reliable.

COMPRESSION PLANT DESIGN

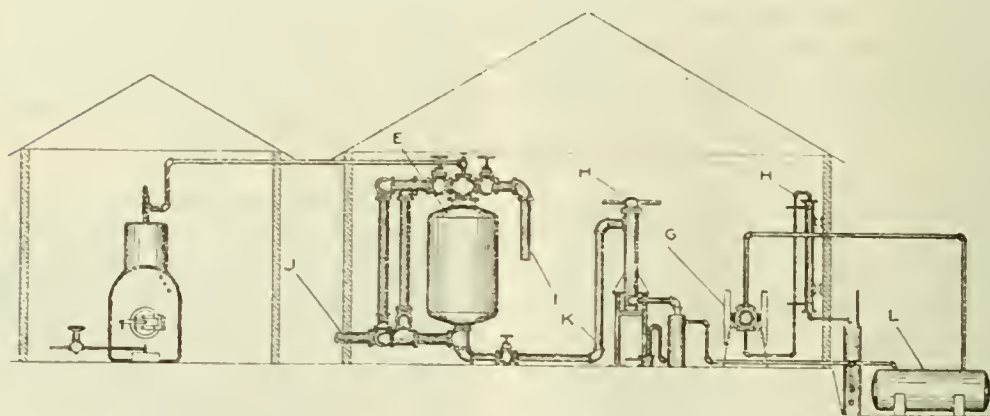
In fixing the size of a compression plant based on small-scale tests, one has to make allowance for a future decrease in the quantity of the gas resulting from the action of vacuum pumps which sooner or later partially exhaust the gas; as this occurs the gas becomes richer in gasoline, and sometimes the net yield of gasoline increases considerably. However, the quantity of gas invariably declines.

Four- to six-inch main gathering lines are used for connecting groups of wells to the plant, and two-inch lines are laid from the main lines to the individual wells. Vacuum pumps are placed preferably at the plant, but at times the distance from the wells may be so great as to necessitate placing the pumps in the field, and using booster pumps to take the gas from the discharge-side to the vacuum pumps and force it, at 0—10 lb. pressure, to the suction side of the compressors at the plant. Compressors of different type are on the market.

Cooling-coils are preferably of the atmospheric type, consisting of 2-inch coils in headers on which



Plan



Elevation

A—Storage tanks
B—Gas cooler
C—Absorber No. 1
D— " No. 2
E— " "
F—Boiler

G—Compressor
H—Condenser
I—Treated gas outlet
J—Untreated gas inlet
K—Vapour line
L—Run tank

Fig. 1.—Gasoline Extraction Plant
Charcoal recovery process

water drips, frequently from sprays in a cooling tower. The radiating area of the coils is usually 0.6—0.7 sq. ft. per 1000 cb. ft. of plant capacity.

Run tanks, which collect the condensate direct from the coils, are equipped with automatic traps to discharge the condensate into storage tanks. The discharge gas should be passed through an absorption tower, preferably in contact with naphtha to extract the last portions of gasoline.

The plant, if possible, should be located close to a railroad so as to provide for inexpensive shipment of the product; but many small plants ship their product in steel drums, of 50 gallons capacity, by means of auto-trucks.

There follow data covering four compression gasoline plants located in different parts of the United States.

less fuel. The industry principally uses steam because the fire hazard is thus reduced.

Oil cooling-coils are best made of 2-inch pipe arranged in headers, and with about 1.0 sq. ft. of surface per gallon of oil circulated per hour. Those of the atmospheric cooling type are best.

Fuel Consumption.—In many absorption plants fuel is the largest item of cost. To reduce it as much as possible, gas-engine power should be employed to run the pumps, compressor, generator, and small items of tool machinery, with the exception that if steam is employed for distillation, enough is used in two or three of the pumps to provide exhaust steam for the stills, otherwise steam would have to be generated for this purpose alone. In most compression plants fuel is not an item, because gas otherwise wasted is used; hence

Data Relating to Compression Plants

Plant No.	Low-stage compression										High-stage compression				
	Intake			Discharge		Cooling coils				Compressor discharge			Cooling coils		
	Rated horse-power	Pressure inches of vacuum	Temp. deg. F.	Pressure lb. per sq. in.	Temp. deg. F.	Total surface area sq. ft.	Sq. ft. per h.-p.	Sq. ft. 1000 cb. ft. gas	Discharge temp. deg. F.	Pressure lb. per sq. in.	Temp. deg. F.	Rated horse-power	Total surface area sq. ft.	Sq. ft. per h.-p.	Sq. ft. 1000 cb. ft. gas
1a	55	2		55		220	4.0	0.490	68 (20°C.)	250		55	220	4.0	0.490
2b	900	6	80	35	245	3600	4.0	0.481	76	250	245	900	3600		
3c	50	3	(26.7°C.)	45	(118.3°C.)	210	4.2	0.600	(24.4°C.)	250	(118.3°C.)	50	420	8.40	1.20

a Plant produces daily 700 galls. gasoline of sp. gr. 0.6731—0.6667 from 450,000 cb. ft. of gas.

b Plant produces daily 7,500 galls. gasoline of sp. gr. 0.7000 from 7,500,000 cb. ft. of gas.

c Plant produces daily 1,500 galls. gasoline of sp. gr. 0.6195 from 350,000 cb. ft. of gas.

(From Bulletin 151, U.S. Bureau of Mines.)

DESIGN OF OIL-ABSORPTION PLANT

The design of oil-absorption gasoline plant requires more skill than the design of compression plants. The nature of an oil plant lends itself to the design of a multitude of apparatus for performing the work, and many fantastic kinds of absorbers, stills, heat-exchangers, vent-tanks, etc. were built in the early days of the industry. At the present time, however, designs are fairly well standardised, and different plants now being built are fairly uniform in construction.

Absorbers should be of the vertical type and up to 60 ft. high. Their diameter is limited by the pressure they have to withstand. Twelve feet for low- and 3 ft. for high-pressure absorbers are the customary maxima.

Heat-exchangers are preferably of the double pipe type, because when properly welded they do not leak so readily as those of the built-up tubular types; but the latter are more efficient. They should be designed to give about 0.25 to 0.30 sq. ft. of exchange-surface per gallon of oil circulated per hour.

Steam stills will vary from 4 ft. in diameter and 15 ft. long for heating about 2800 galls. of oil per hour to 12 ft. in diameter and 35 ft. long to treat 20,000 galls. of oil. Pan-type stills heated with free steam, are best when steam is used as the distilling medium, but direct fire-heated stills consume

no special economy is practised at the power station of a compression gasoline plant.

QUANTITY OF OIL REQUIRED

The quantity of oil necessary to circulate through an absorption plant will vary with the gasoline-content of the gas and with its pressure. More oil is required at low pressures. This follows from well-known laws. The quantity actually required has been found by much experience to vary from about 4 galls. for 1000 cb. ft. of gas at pressures of 150 lb. or more, and containing about one-eighth gall. of gasoline per 1000 cb. ft. of gas, to 150 galls. per 1000 cb. ft. for gas treated at 5 lb. pressure and containing eight galls. of gasoline per 1000 cb. ft.

The cost of constructing an absorption plant depends upon the richness of the gas, the amount of gas, and the pressure under which the gas is treated. A plant handling 20 million cb. ft. of gas at 150 lb. pressure, and containing 200 galls. of gasoline per million cb. ft., will cost about \$150,000.00, completely erected.

CALCULATIONS FOR DESIGN

The steam, water, heat-exchange cooling area of coils, fuel requirements, etc. can all be fairly closely calculated after preliminary tests have been made of the gasoline-content of the gas and its pressure and quantity.

Steam requirements can be based on the following average data:—

Temperature of oil entering still ..	135°F. (57.2°C.)
Temperature of vapours from still ..	210°F. (98.9°C.)
Temperature change ..	75°F. (23.9°C.)
Specific heat of absorption oil ..	0.50
Weight of absorption oil ..	7 lb. per gall.
Heat required to raise 1 gall. absorbent oil from 135°F. (57.2°C.) to 210°F. (98.9°C.) =	$75 \times 0.50 \times 7 = 262.5$ B.Th.U. per gall.
Specific heat of gasoline ..	0.58
Latent heat of gasoline ..	100 B.Th.U. per lb.
Weight of gasoline ..	5.5 lb. per gall.

The water requirements for the gasoline cooling-coils can be calculated from the temperature of the gasoline vapour leaving the knock-out box, which will be about 180° F. (82.2° C.), its final temperature, which can be assumed to be about 60° F. (15.6° C.), and the specific heat and latent heat of the gasoline. The last is about 100 B.Th.U.

The water for the oil cooling-coils can be calculated from the temperature of the oil leaving the heat-exchangers, which will be about 160° F.

(71.1° C.) in open steam-stills, its final water-cooled temperature before entering the absorbers, about 70° F. (21.1° C.), the temperature of the water before and after it is used to cool the oil, approximately 60° F. (15.6° C.) and 100° F. (37.8° C.), respectively, and the specific heat and weight in pounds per gallon of the absorbent oil.

The capacity of the absorbers in terms of cubic feet of gas per 24 hours can be approximately determined from the formula:—

$$Q = 31.4 \cdot 16d^2 \sqrt{\frac{P}{G}}$$

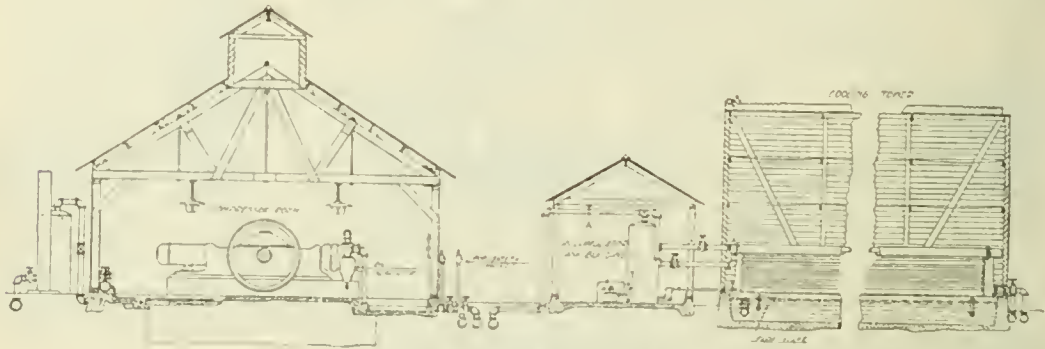
where P=absolute gas pressure.

G=density of gas.

Q=capacity in cb. ft. per 24 hours.

d=diameter in inches.

The diameter of the absorbers is determined by the gas pressure which they have to withstand. The spreading or absorbent surface of the filler used



From Bulletin 151, U.S. Bureau of Mines.

Fig. 2.—Compression Plant

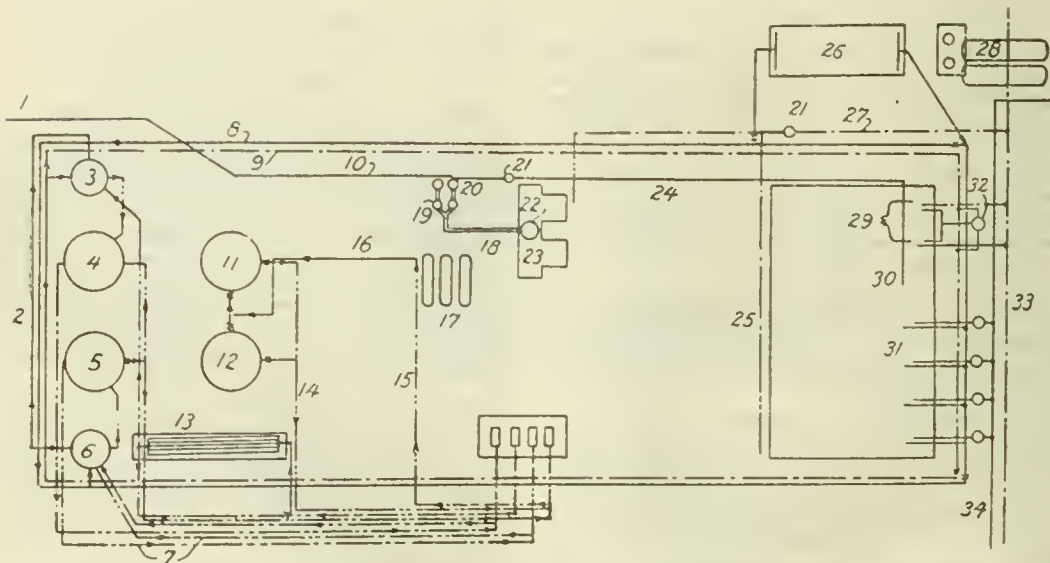


FIG. 3.—General lay-out of plant; 1, to storage; 2, by-pass for gas; 3, No. 2 absorber; 4, 5, saturated oil; 6, No. 1 absorber; 7, recirculation lines; 8, wet gas; 9, dry gas; 10, gasoline to tanks; 11, residue; 12, storage; 13, cooling-coil for gas oil; 14, residual gas to cooler and absorber No. 2; 15, saturated oil to still; 16, residue from still; 17, heat-exchangers; 18, vapour stack; 19, dephlegmator; 20, condenser; 21, trap; 22, evaporator; 23, still; 24, still vapour to compressor; 25, engine fuel line; 26, compressor and wet-gas cooler; 27, fuel line; 28, blending drums; 29, boosters; 30, still-vapour compressors; 31, 4 vacuum pumps; 32, scrubbers; 33, dry gas to field; 34, wet gas.

Fig. 3.—General Lay-out of Oil-Absorption Plant.

(From Technical Paper 263, U.S. Bureau of Mines.)

inside the absorbers decreases their capacity, and allowance has to be made for this. Their diameter also should be such that the velocity of the gas through them does not exceed 150 feet per minute, otherwise absorbent oil will be carried out of them and into the gas lines by the gas, despite oil-traps placed to catch the oil.

The amount of piping required in constructing the heat exchangers and oil cooling-coils can be calculated from the constants already given.

GENERAL

The industry is now firmly established. Its future growth will not be so rapid as its growth in the past because a tremendous amount of gas, long wasting its gasoline, was "caught up with" and treated, as operators learned of possibilities in extracting the gasoline. Every oil and gas well is, however, a potential gasoline producer, and just as the natural gas and petroleum industry thrives, so will its by-product industry, the natural-gas gasoline industry.

More natural-gas gasoline will be required each year for mixing with heavy refinery distillates to make them suitable for motor use, thus providing the low-boiling constituents needed to make motor-engines start and to accelerate them when running.

Users of gasoline in Europe demand a much higher grade of gasoline for their motor cars than do consumers in the United States. Hence a very large amount of natural-gas gasoline is added to gasoline destined for exportation.

Different grades of natural-gas gasoline are sold at the present time. The most desirable and the highest priced gasoline in the country is so-called "straight absorption gasoline" of sp. gr. about 0.6667. This grade suffers less loss by evaporation than others, in its handling and utilisation. Other grades consist of "straight compression gasoline" of different distillation-ranges and end-points, and a host of blends ranging from specific gravity 0.667 upwards.

Refiners, of course, prefer to buy the crude natural-gas gasoline product and mix it with their refinery "cuts." On the other hand natural-gasoline operators prefer to do this blending themselves at their plants because they save thereby much "wild" gasoline which they could not otherwise retain. The refiner has the upper hand in the argument because he has better access to the retail markets and can better dispose of blends than the natural-gas gasoline operator. The ideal combination is that of a company possessing both refineries and natural-gas gasoline plants; all the large oil companies are in this position.

Natural-gas Gasoline: Distillation Data

Per cent.	A		B	
	Typical compression product Sp. gr. 0.6114 Deg. F.		Typical absorption product Sp. gr. 0.667 Deg. F.	
Initial	..	54 (12.2°C.)	..	75 (23.9°C.)
10	..	68 (20.0°C.)	..	98 (36.7°C.)
20	..	73 (25.6°C.)	..	114 (45.6°C.)
30	..	87 (30.6°C.)	..	127 (52.8°C.)
40	..	98 (36.7°C.)	..	141 (60.6°C.)
50	..	112 (44.4°C.)	..	155 (68.3°C.)
60	..	134 (56.7°C.)	..	172 (77.8°C.)
65	..	160 (71.1°C.)	..	—
68	..	190 (87.8°C.)	..	—
70	..	—	..	190 (87.8°C.)
80	..	—	..	218 (103.3°C.)
90	..	—	..	276 (135.6°C.)
92	..	—	..	302 (150°C.)
Loss 32 per cent.		..	Loss 8 per cent.	

Both these compression and absorption products were withdrawn as made without blending or allowing them to "weather." In actual plant practice, the compression product is both blended and weathered in order to save as much of the "wild" parts as possible and to reduce the vapour pressure to conform with shipping regulations.

SAFEGUARDING OF INDUSTRIES ACT

SODIUM PHOSPHATE

A complaint to remove "sodium phosphate" from the list of dutiable articles was preferred by the Chemical Merchants' and Users' National Vigilance Committee (represented by Mr. K. Swan and Mr. R. L. Parry), and opposed by the Board of Trade (Mr. Whitehead) and Thomas Tyrer and Co., Ltd. (Sir A. Colefax, K.C., and the Hon. S. Cripps). The one and only sitting, held on November 25, was devoted to a consideration of the form of the complaint. For the complainants Mr. Swan contested that the term "sodium phosphate" was often used by the trade in a generic sense, i.e., as including the three sodium salts of orthophosphoric acid and sodium pyrophosphate; these substances were all heavy chemicals. The opponents held that to chemists, the trade, and the public "sodium phosphate" meant di-sodium hydrogen phosphate and none other; as this substance was included in the Board's list with the prefix "R" and not otherwise, they contended that the Referee had no power to hear or adjudicate on any complaints in respect of other substances. Without prejudice to this objection, the Board asserted that sodium phosphate, mono-, sodium phosphate, di-, "R.," sodium phosphate, tri-, and sodium pyrophosphate were each of them fine chemicals, and that sodium phosphate, di-, "R.," was also extensively used as an analytical reagent. Sir A. Colefax urged that the notice of the complaint was bad because it did not specify any particular phosphate. After much legal argument, the Referee said he would take evidence as to whether "sodium phosphate" had a specific meaning or not. Mr. Swan then handed in a "family tree" showing the relationships between the three sodium salts of orthophosphoric acid, the sodium salts of pyrophosphoric acid and sodium metaphosphate, contending that the term "sodium phosphate" covered all these substances.

Mr. E. J. Parry, in his evidence, referred to a number of text-books and chemical dictionaries of somewhat ancient date in which the term "sodium phosphate" was used rather loosely, but in reply to the Referee said he could not show any reference to "sodium phosphate" being used to connote any substance other than disodium hydrogen phosphate. Speaking as a chemist, the expression "sodium phosphate" was used generically in all the text-books, but when he saw the words "sodium phosphate" alone and without qualification, he understood them to mean the disodium orthophosphate. Cross-examined by Sir A. Colefax, Mr. Parry repeated a previous assertion to the effect that although ortho-, pyro-, and metaphosphoric acids were distinct chemical individuals, they were always treated as separate varieties of phosphoric

acid; they were modifications of one original substance. Sir A. Colefax contended that they were not modifications of any single substance, and asked witness for its formula. Mr. Parry replied that there were three formulae.

The Referee's award, dated December 4, is as follows:—

In this case the complaint referred to me is that sodium phosphate has been wrongly included in the list of dutiable substances. The complainants claim that under this complaint they are entitled to ask me to consider the propriety of the inclusion in the list of: Monobasic phosphate of sodium; dibasic phosphate of sodium; tribasic phosphate of sodium; and pyrophosphate of sodium, both in the neutral and acid varieties. The words "sodium phosphate" do not occur in the list without some further word of description. It is therefore necessary to determine which article or articles in the list is or are referred to by these words.

It is the duty of a complainant to indicate with at least reasonable certainty which article is the subject of his complaint. There is no difficulty about using the exact description appearing in the list. Departure from such a course must lead to ambiguity. The evidence called by the complainants established quite clearly, and I find as a fact, that both in the trade and among chemists "sodium phosphate" is the substance described in the list as sodium phosphate, di-.

The evidence does not suggest that the words "sodium phosphate" have been used or are used to describe any other substance. Yet I am asked to treat the words as co-extensive with the words "phosphates of sodium." I do not think I should be justified in so doing. I cannot see how I can give the words "sodium phosphate" any meaning other than that which they in fact have. The result is that the only article which I have jurisdiction to consider is that described in the list as sodium phosphate, di-. The letter "R" appears against it in the list, and it is conceded that so qualified the inclusion is not open to objection. The complaint therefore fails. No costs.

I understand that there are other complaints referring specifically to sodium phosphate, mono- and tri-. Nothing I have said prejudices in any way the further prosecution of these complaints.

OXALIC ACID

A complaint, lodged by the Chemical Merchants' and Users' National Vigilance Committee, that oxalic acid had been improperly included by the Board of Trade in the list of articles subject to duty under Part I of the Act, was heard by Mr. Cyril Atkinson, K.C., on November 11, 17, 18, and 20. The complaint was opposed by the Board of Trade (represented by Mr. Whithead) and by certain other interests, and by J. D. Pritchard and Co., Ltd., of Swansea, formerly manufacturers of oxalic acid by the potash-fusion process. This firm was represented by Sir Arthur Colefax, K.C., and the Hon. S. Cripps, and the complainants by Mr. K. Swan and Mr. R. Lambert Parry.

Early in the proceedings Sir A. Colefax stated he would mainly rely upon the contention that oxalic acid was a synthetic organic chemical, and to a less extent he would claim that it was an analytical reagent when in a very high state of purity. The Board of Trade maintained that oxalic acid was not

only a fine chemical by reason of its method of manufacture, but a synthetic organic chemical and an analytical reagent.

Mr. Swan's case was that oxalic acid is a heavy chemical; if that were proved it would follow from the wording in the schedule that oxalic acid was not a synthetic organic chemical, or an analytical reagent, or any other fine chemical. [The relevant words of the Schedule are: "Synthetic organic chemicals (other than synthetic organic dyestuffs, colours and colouring matters imported for use as such, and organic intermediate products imported for their manufacture), analytical reagents, all other fine chemicals (except sulphate of quinine of vegetable origin) and chemicals manufactured by fermentation processes."] According to the trade a synthetic organic chemical was a fine chemical; the process of manufacture of oxalic acid through sodium formate was not truly synthetic; and oxalic acid was only used in minute amounts as an analytical reagent.

The Referee stated that he would adopt the definition of "synthetic" that he laid down in the camphor case:—

"The word 'synthetic,' as used in the Act, means a building-up of carbon compounds either from their constituent elements or from groups of differently constituted molecules by orderly steps, the result of which can be followed, and from which the constitution of the structure can be deduced or inferred" (*cf. J.*, 1922, 239 n).

Mr. A. F. Butler, of R. W. Greeff and Co., Ltd., said that the trade had always regarded oxalic acid as a heavy chemical: in lists issued by his firm in 1914 and 1922 it was classified as a technical chemical, and (in answer to Sir A. Colefax) it appeared in one recent list under the heading "Fine Chemicals and Pharmaceutical Products." He had never heard it described in the trade either as a synthetic organic chemical or as an analytical reagent. Before the war commercial oxalic acid was of 99–100 per cent. purity, but to-day from 93 to 100 per cent. Prior to hostilities his firm was agent for a German combine of manufacturers and he dealt with the agency known as the *Verkaufs-stelle für Oxalsäure*. Nearly all the acid he had imported in 1921 came from Holland, where it was manufactured, he believed, by the formate process.

Mr. W. G. Wilson, a director of Charles Page and Co., Ltd., gave similar evidence. In addition to trading with Germany and Holland, his firm imported a little oxalic acid from Norway and from the United States, representing in this country the Victor Chemical Works, of Chicago, where the output, by the formate process, was over 1000 tons per annum. American oxalic acid could not compete in Europe. His firm dealt in quantities ranging from one cask (up to 5–8 cwt.) to 10-ton lots, and sold it mainly to the textile and leather industries and for bleaching straw.

Mr. John Brown, of Brown and Forth, Ltd., said that he always associated the term "fine chemical" with a B.P. standard of purity. He imported oxalic acid in 5–10-ton lots from Holland, Germany, and Norway, and he also bought from Pritchards, but this firm could not compete with the foreign suppliers. America, however, was "down and out." He was not importing oxalic acid at the present time, preferring to wait to see which way the cat jumped. (The Referee: "Am I the cat?")

Mr. E. J. Parry stated that he had searched trade literature and found that oxalic acid was always classed as a heavy chemical except in two places, in this *Journal* and in the price list of Greef already mentioned. He did not regard the process of manufacture through sodium formate as a synthetic process in the sense laid down by the Referee (*cf. s.*). The first stage of that process, viz., the reaction (a) $\text{NaOH} + \text{CO} = \text{H.COONa}$, was exactly analogous to the reaction between caustic soda and carbon dioxide, and if the formate was called "synthetic," so also must be sodium carbonate. No organic radicals took part in this reaction, and there was no increase in the number of carbon atoms. The reaction *per se* gave no clue to the constitution of sodium formate. The next stage: (b) $2\text{H.COONa} = \text{H}_2 + (\text{COONa})_2$, was a mere decomposition at a very high temperature and lacked every characteristic of synthesis ("a temperature of 400°C . is totally antagonistic to any idea of synthesis"); the course of the reaction was entirely unpredictable. Only if the word "synthetic" were used in the sense of "artificial" could oxalic acid made by this process be called a synthetic organic chemical; and if this broad sense of the word were used, a great number of admittedly heavy chemicals would have to be included. On the point that oxalic acid was claimed to be an analytical agent, Mr. Parry said that its use for this purpose had become discredited; personally, he had not used it for ten years, sodium or ammonium oxalate was now always used instead.

Cross-examined by Sir A. Colefax, who asked if the synthesis of urea from ammonium cyanate was not everywhere admitted to be a true synthesis, although it involved no building up of carbon atoms, Mr. Parry said he would prefer to call it a "preparation"; and he admitted that the analogy between reaction (a) and the action of carbon dioxide on caustic soda was not complete in that in the latter case there was a simultaneous production of water. Reaction (b) was not a synthesis because, for one reason, it was not possible to follow the intermediate steps; probably a considerable number of subsidiary reactions took place and the yield of oxalic acid was only about 45–55 per cent.; but in the first stages of all the classical syntheses the intermediate steps were generally not known. Further, one could not deduce the constitution of the acid from this reaction. He did not regard the polymerisation of acetylene into benzene as a true scientific synthesis, but only a synthesis if that word were used as synonymous with "artificial," in which sense it was often used by chemists. Asked why he did not regard reaction (a) as synthesis, he replied that, except in a few cases, the word "synthetic" was not applied to inorganic chemicals; if it were, nearly every inorganic heavy chemical would be synthetic.

Dr. J. Gordon Parker, the sole witness for J. D. Pritchard and Co., said that if he had been asked five years ago, he would certainly have replied that oxalic acid was a fine chemical, because he had always associated heavy chemicals with productions of hundreds of thousands of tons and with comparative ease of manufacture. He had never heard the mode of preparation through sodium formate referred to otherwise than as a synthetic process, and it was so designated by a large number of authoritative text-books (Ullmann, Perkin and Kipping, Richter, Roscoe and Schorlemmer,

Molinari, etc.). He disagreed with Mr. Parry that the final product of a reaction was not synthetic, (a) if its constitution could not be inferred from the method of preparation; (b) if there were subsidiary reactions involving destruction of intermediate products and formation of by-products; and (c) if a high temperature played a part in the process. It was customary for tanners to keep oxalic acid in the same store as reagents, the finer dyes, and fine chemicals. The process of manufacture necessitated very careful control.

In cross-examination by Mr. Swan, Dr. Parker said that in his view "synthesis" did not imply any necessity to be able to deduce the constitution from the reaction or reactions; and in the Referee's definition (*cf. s.*) he would prefer the word "likely," i.e., not haphazard, to "orderly" (steps). Reaction (a) was a synthetic reaction and sodium formate a synthetic organic product. Organic synthesis did not only mean addition of carbon but of hydroxyl and other groups. In the technical process of manufacture the yield was much higher than 65 per cent. Examined by Sir A. Colefax, witness gave as an instance of an organic synthesis taking place at a higher temperature, the conversion of acetylene into benzene; from this reaction alone, the constitution of benzene could not be inferred. An important difference between the reactions of caustic soda with carbon dioxide and carbon monoxide was that the dioxide was the anhydride of an acid, whereas the monoxide was not. He did not regard the manufacture from sawdust as a synthetic process.

Dr. L. A. Jordan, who is the manager of a syndicate about to promote the manufacture of oxalic acid in this country by a new process, said he had specialised in the manufacture of synthetic organic compounds, and he held the view that oxalic acid was a fine chemical; it was of a high degree of purity, and was made neither in very big quantities nor in large batches, by a process which needed careful supervision and skilled labour. Beyond applying the usual tests for a fine chemical he was a chemist and knew by instinct what was a fine chemical and what was not (Referee: "I wish I did"). Oxalic acid was a synthetic organic chemical; he could not imagine any chemist doubting it; it was built up by a series of operations which were individually and collectively synthetic, and which involved the commonest ideas on synthesis such as linking of carbon atoms and a progressive increase in molecular weight, although these points were not absolutely essential to synthesis (*e.g.*, the synthesis of urea, and of aniline from nitrobenzene). The most important points in a synthesis were knowledge of the initial substance and of the final product; knowledge of the intermediate steps might assist in deducing the constitution of the product, but to this end other data, derived from analysis and determination of molecular weight and basicity, had also to be obtained. The Referee alluded to the definition of synthesis used in the camphor case and asked the witness if he could adduce examples of synthesis in which the reacting molecules were not dissimilar. Dr. Jordan instanced the formation of diphenyl from benzene, of the hexoses, $\text{C}_6\text{H}_{12}\text{O}_6$, from formaldehyde, and the condensation of benzaldehyde to form benzoin. In reply to the further question "if as the result of experimentation you arrive at a substance B but want A, is B a synthetic product?" the witness related a number of

classic instances in which discoveries now recognised as syntheses had resulted from reactions following unforeseen courses. Finally, Dr. Jordan stated that he took a very wide view of the term "synthesis"; practically all artificially prepared carbon compounds were synthetic, but, of course, there were organic compounds, *e.g.*, certain alkaloids, which had not yet been synthesised.

In his final speech, Sir A. Colefax dealt with certain of Mr. Swan's fallacies, as he termed them. The interpretation that if oxalic acid is not a fine chemical, it cannot be a synthetic compound, was untenable. No one on his side had maintained that every step in a synthesis must itself be synthetic; or that it was essential to be able to deduce constitution from any one reaction involved in a synthesis. The question of high temperature was irrelevant. Although the bulk of the trade evidence was in favour of the view that oxalic acid was a heavy chemical, he would rely upon the abundant evidence to the contrary, supplied by the text-books and Drs. Parker and Jordan.

Mr. Whitehead said that the production of phenol from benzene was a clear case of synthesis not involving an increase in the number of carbon atoms. Mr. Swan's construction, that if oxalic acid was not a fine chemical, it could not be a synthetic organic chemical, was quite wrong; in law, they did not use general terms to define particular terms, but *vice versa*. On the question of inferring constitution, he submitted that synthesis depended entirely upon the possibility of inferring and not upon the intention of the chemist when he started work or upon the accomplishment.

Mr. Swan, in his address, recalled the evidence as to trade usage which was to be found in the catalogues, price lists, Kelly's Directory, and trade journals; and he contended that this view applied equally well to oxalic acid made by the formate method as by the sawdust process. He reiterated his view of the interpretation to be put upon the wording of the Act, submitting that all synthetic organic chemicals were fine chemicals, and even if that view were wrong the inclusion of a heavy chemical, *i.e.*, oxalic acid, among them would be anomalous and unique. On the question of synthesis he took his stand upon the definition given in the camphor case; Sir A. Colefax had shifted his ground in that respect. Nothing could be gained from a text-book definition unless the author stated what he meant by "synthetic," and he urged that a reaction could not be called synthetic if it were unintelligible or obscure. In the present case the evidence was conclusive that the reaction involving the transition from formate to oxalate was not known with certainty; if it were understood with certainty to-morrow, it would become synthetic. The acetylene-benzene reaction involved the artificial production of benzene; it was not a synthesis within the meaning of the Act.

The Referee's award was issued on December 18, as follows:—

The question in this case is whether oxalic acid is properly included in the list of dutiable articles. The inclusion in the list is justified on three grounds:—1. That oxalic acid is a synthetic organic chemical. 2. That oxalic acid is a fine chemical. 3. That oxalic acid is an analytical reagent. I am not satisfied that oxalic acid is a fine chemical. Indeed, I think it is not. I am quite satisfied that its inclusion cannot be justified on the ground that

it is an analytical reagent. But I have come to the conclusion that it is a synthetic organic chemical, and as such rightly included in the schedule.

The question whether oxalic acid is a synthetic organic chemical is one of considerable difficulty. It is, I think, entirely a matter of opinion, depending upon the particular view held as to the precise limitations of the meaning of the word synthetic. In the synthetic camphor case I accepted the following definition of synthesis: "A building-up of carbon compounds either from their constituent elements or from groups of differently constituted molecules by orderly steps the result of which can be followed and from which the constitution of the structure can be deduced or inferred." It may be that on some future occasion it will be necessary to reconsider this definition, but I do not understand that this definition is challenged by either side in this case. The difference of view has reference to the question whether the steps in the building up of oxalic acid from caustic soda and carbon monoxide come within it. There is no doubt that oxalic acid is an organic body which can be built up from its elements. The process begins with the use of carbon, the number of carbon atoms in the molecule is increased and the molecule becomes heavier. The molecular construction contains two atoms of carbon linked together. Although in practice the first step in building up is the combining of carbon monoxide and caustic soda, both these substances can be obtained from their elements.

The real dispute is as to whether the steps taken in the building up are orderly steps and steps from which the structure of the resulting molecule can be deduced or inferred.

The decision seems to turn upon the view taken of the main step—the heating of the sodium formate causing the hydrogen to be liberated and the two unsaturated links to combine, forming sodium oxalate. The temperature necessary to produce this reaction is no haphazard temperature. A temperature of 440° C. or thereabouts is necessary except in the presence of sodium carbonate or certain other substances when a lower temperature will suffice, *viz.*, 300° to 350° C. In this sense it is a controlled temperature. It seems to me quite impossible to rule out a reaction depending upon a controlled degree of heat from those steps regarded as synthetic. But it is said that it is impossible to draw any inference as to the structure of sodium oxalate from the reaction in question. If the molecular structure of a substance is known before it is synthesised, and that knowledge is capable of suggesting, and does suggest, steps which may possibly bring about that result and then by experiment it is found that these steps do in fact produce that result, it seems to me that such steps are entitled to be considered as synthetic. I think that one might well have reasoned that if by heat the hydrogen could be expelled from the molecule H.COONa leaving the unsaturated link COONa it was at least possible that two or more of these links might combine and give the structure desired. The reasoning back from a known structure seems to me to be just as much a basis of synthesis as the reasoning forward towards an unknown structure. Further, I do not think that the definition demands that the hypothetical operator should know exactly what is going on during the experimental reaction.

The view I take after a very careful review of the evidence both in this and the camphor case is that

oxalic acid obtained by the formate process is synthetic. There is one other matter with which I must deal, namely, Mr. Swann's argument that the expression "synthetic organic chemicals" is limited to fine chemicals. He relies on the words "all other fine chemicals" as indicating that this part of the schedule is only intended to cover chemicals that are fine. There seem to me to be insuperable difficulties about this view. It would give no independent effect to the words "all synthetic organic chemicals" or "analytical reagents." I quite agree that the word "other" creates a difficulty, but I adhere to the view I expressed in the sodium phosphato case that the particular description "all synthetic organic chemicals" cannot be cut down or defined by the more general words "all other fine chemicals." I therefore decide that oxalic acid manufactured by the formate process is properly within the schedule. It is conceded that the acid imported into this country is all manufactured by this process. I therefore award that the complaint fails.

CHEMICAL INDUSTRIES IN CANADA

The Dominion Bureau of Statistics has recently published a report on the production of chemicals and allied products in Canada for the calendar years 1919 and 1920. The statistics cover the following groups: Coal tar and its products; acids, alkalis, salts and compressed gases; explosives, ammunition, fireworks and matches; fertilisers; medicinal and pharmaceutical preparations; pigments, paints and varnishes; soaps, perfumery, cosmetics and other toilet preparations; inks, dyes and colour compounds; wood distillates and extracts; miscellaneous chemical industries. The report is disappointing in so far as the number of industries treated is limited; the paper and pulp, alcohol, glucose and other well-known industries, involving the application of chemical methods and generally associated with chemistry, are, unfortunately, not included, and the reason for these exclusions is not quite clear. Technologists and others having occasion to consult the Canadian report may conclude that many substances which are classed as chemicals are not made in Canada, and there would be good ground for such opinion, because of the detailed information regarding such industries as the manufacture of baking powder, cosmetics, and shoe blacking, which are treated fully in the report.

The report, although somewhat circumscribed in the industries treated, and also belated in making its appearance, is instructive and will prove a source of valuable information; the statistics are more authoritative, fuller, better arranged, and more free from anomalies than any issued in previous bulletins upon these industries. In some instances the textual comment is of such a character that it may induce the manufacturer to think and investigate his methods with a view to ultimately increasing production and lowering cost of manufacture.

The returns for the year 1919 practically cover the transition period arising from the abnormal conditions of war to those of peace, and is particularly marked by the falling-off in the output of the

chemical industries employed in the manufacture of war materials.

	1919	1920
Total plants operated	429	456
Par value of stocks and bonds held in—	\$	\$
Canada	31,905,063	38,930,012
Great Britain	21,869,160	23,417,928
U.S.A.	121,622,220	120,161,009
Other countries	583,091	1,221,247
Total	\$175,979,543	\$192,730,256

From the foregoing it will be observed that in 1919 nearly 70 per cent. of the par value of stocks and bonds was held by residents of the United States, and that in 1920 this figure had fallen to about 66 per cent.

The total capital, including fixed assets—as lands, buildings, machinery, etc.—and liquid assets—as stocks and materials on hand—was \$111,760,019 in 1919, and \$118,840,897 in 1920, the capital being almost equally divided between the fixed and liquid assets. The average number of employees and amount of wages paid for the respective years were as follows:—

	1919 No.	1920 No.
Males, salaried	2,539	2,790
Females, salaried	834	890
Male wage-earners	9,190	10,623
Female wage-earners	3,040	2,980
	\$	\$
Salaries	5,674,203	7,115,734
Wages	10,710,226	14,580,398
Salaries and wages (total)	16,384,429	21,736,132

The average salary for 1919 was, approximately, \$1680, and for 1920 about \$1940; the approximate wage rate for the respective years was \$875 and \$1070. The percentage ratio of the numbers of salaried and wage earners in the two years was almost constant.

The following financial statistics cover the costs of fuel, materials, miscellaneous expenses, total expenditure (including wages and salaries), and selling value of product:

	1919.	1920
	\$	\$
Fuel	2,009,526	3,298,117
Materials	48,303,812	60,082,027
Miscellaneous	17,667,486	21,053,223
Total expenditure	84,365,253	106,877,136
Selling value of products	96,463,988	121,789,336

The total power equipment in 1919 was as follows:—Total rated horse-power of prime movers (exclusive of boilers), 77,171; alternating current, 5896 kv.a., and direct current, 5746 kw. In the year 1920 the total rated horse-power of prime movers employed (exclusive of boilers) was 293,380.

The difference between the selling value of the products in 1919 and the total expenditure was \$12,098,735, being about 14.4 per cent. in favour of the former; in 1920 these figures were \$15,619,837 and 15 per cent. respectively. Calculating these differences in relation to capital—fixed and liquid assets—they represent in 1919, 10.8 per cent. and in 1920, 13.1 per cent. upon total invested capital.

An examination of some of the expenditure charges is interesting in view of the fact that the excess profit tax and income tax were practically *post bellum* enactments. An industry in which a large portion of the capital is invested in land and in buildings and machinery, which should not call for expensive repair, in 1919, charged 4 per cent. upon the fixed capital to repairs of buildings and machinery, and 13.8 per cent. in 1920; these

and wages paid for the respective years, represent the cost of repairs as 32.2 and 64.4 per cent. The buildings and machinery, although in active use in 1918, must have suddenly developed marked signs of post-war weakness, which undoubtedly brought pleasure and relief in the preparation of the taxation schedule.

The values of the imports of chemicals, under the classes enumerated in the report, have been as follows: 1919, total \$34,282,647, of which \$3,397,095 came from the United Kingdom, \$28,719,765 from the United States; in 1920 the total was \$29,886,102, derived as follows: U.K. \$4,154,345; U.S.A. \$23,854,300. In 1921, total \$36,334,612; U.K. \$6,048,717; U.S.A. \$26,766,364. In 1922, total \$24,041,885; U.K. \$3,238,465; U.S.A. \$17,688,482.

The exports were as follows: 1919, total \$56,799,799; \$20,176,855 to U.K., \$30,671,606 to U.S.A.; 1920, \$22,581,049; \$3,595,936 U.K.; \$13,803,067 U.S.A.; 1921, \$19,582,057; \$3,225,947 U.K., \$11,694,853 U.S.A.; 1922, \$9,271,027; \$939,529 U.K., \$5,937,114 U.S.A.

The above customs returns are for the fiscal years ending March 31 of each of the above years.

The imports were at a maximum in the year 1921, in which period the output of Canadian industries was the greatest in value since the termination of the war. The exports in 1919 were the highest ever attained, owing to the shipment of military stores; since that year there has been a steady and heavy decline.

The calendar year 1921 exhibits a marked decrease in value of chemicals produced (\$77,748,000), plants employed (414), capital (\$109,225,000), employees (12,289), salaries and wages (\$15,853,000), and cost of material (\$36,203,000). Notwithstanding the decline in the chemical industry during the past year, the statisticians are of the opinion that the worst is past, and that Canadian chemical trade will advance to a higher position than it ever held in pre-war times.

THE COAL INDUSTRY

The Dominion Bureau of Statistics has issued a comprehensive report reviewing the coal industry and trade of Canada in the years 1919—20—21. This is one of the best trade returns published by the Bureau; it contains in detail the output of collieries, imports of coal by ports of entry, exports, information regarding capital invested, plant equipment, men employed, time worked and lost tonnage, and statistics of the production from each province. The apparent coal consumption of Canada is estimated at between 30 and 35 million tons annually, half of which is imported from the United States. In 1921 there were 396 coalmines in operation, covering an area of 713,000 acres. Total capital invested, at the close of the year 1921, was \$176,991,495, of which \$77,000,000 was in British Columbia, over \$3,000,000 in Saskatchewan, and \$1,000,000 in New Brunswick. The coalmining industry gives employment to about 30,000 men, and in 1921 wages amounted to \$42,758,471, and salaries aggregating \$3,717,238 were paid to about 1600 officials.

The two reports referred to are entitled "Chemicals and Allied Products in 1919 and 1920" and "Coal Statistics for the Years 1919, 1920, 1921," respectively, and are published by the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics, Ottawa.

SOCIETY OF CHEMICAL INDUSTRY

NEWS FROM THE SECTIONS

SOUTH WALES

A meeting of this Section was held in the Technical College, Cardiff, on December 1, Prof. C. M. Thompson presiding. Mr. H. W. Webb read a paper on the Oxidation of Ammonia, in which he described some of the pioneer experimental work on the process of manufacturing nitric oxide and nitric acid from ammonia, derived from waste gas liquor, by catalytic oxidation with very fine platinum gauze. The conditions of temperature, the preparation and construction of the catalyst, concentration and purity of the gases, and other factors which govern the capacity and efficiency of the oxidising unit were discussed. It was shown that the mixture of air and ammonia which is sufficiently rich in ammonia to maintain the catalyst temperature at its optimum value, does not yield the highest efficiency. The best result, i.e., an efficiency up to 94 per cent., is obtained by using a mixture containing less than 10 per cent. by volume of ammonia and maintaining the catalyst at about 550° C. Catalyst poisons, especially hydrogen sulphide, phosphine and pyridine, were also dealt with. In the discussion it was pointed out that no unchanged ammonia passes the catalyst, so that the product contains no ammonium nitrate; ammonia not oxidised to nitric oxide appears as nitrogen.

MONTREAL

At the meeting held on November 20, the chairman, Dr. A. R. M. MacLean, presiding, Prof. Ruttan read a message of greeting from the President, Dr. Armstrong, to the Dominion Sections, which was greatly appreciated. There were present about 40 senior students from McGill University and the Université de Montreal, and the spirit of good-fellowship displayed between the two nationalities was a happy augury for still closer co-operation in the future.

"The Manufacture of Calcium Carbide" was the subject of the evening's lecture, by Mr. Witherpoon, General Manager of the Canada Carbide Co., who described the development of the electric furnace from the small experimental Moissan furnace to the present-day furnaces producing a ton an hour by a continuous process. He emphasised the fundamental importance of a correct balance between a given weight of material and a given amount of heat. The best method of mixing the lime and coke, and the degree of fineness of the two substances have been the subject of much experimentation, and the conclusion reached is that rough-mixing of coarsely crushed coke of 4-inch to 1 in. mesh, with lime of 1 in. to 2 in. mesh gives the best yield.

The lecturer then described the developments which led to the adoption of a continuous process of manufacture, the chief of which was the increased supply of current. It was, however, early discovered that a reduction in voltage from the prevailing 75 volts was necessary. Two furnaces were then run in series and an efficiency of 90 per cent. was attained with 1000 kw., but developments rapidly followed, and to-day each furnace is rated at charges, based upon the total amount of salaries

15,000 kw. It is not correct to describe the modern furnace as an arc furnace, as the charge itself is a conductor, and the current passes quietly and steadily through the pasty mass. The arc exists only during the warming-up period, and a true balance in one of these large furnaces is not reached for several days. The different forms of electrodes were described.

The numerous derivatives of acetylene were referred to and a new, entirely Canadian product, Acetylene Black, was introduced to the audience. This substance has a very low specific gravity; it can be easily compressed, and even when compressed is 50 per cent. more bulky than carbon black. Rubber manufacturers have found it satisfactory, and when used in paints it yields a clear neutral grey. As a decolorising black in sugar-refining, and for filtering water, it has proved very efficient.

LIVERPOOL

At a meeting held on December 8, in the University, Dr. J. T. Conroy presiding, a paper was read by Mr. H. M. Langton on "Some Problems connected with the Saponification of Fatty Oils."

After a brief reference to the importance of industrial saponification, the author discussed the theory of hydrolysis of oils and fats, and pointed out that, as a result of the work of Lewkowitsch, Marcusson and others, we must conclude that the saponification of the triglycerides takes place in stages, passing from the triglyceride through the diglyceride to the monoglyceride, and ultimately to the products of complete saponification, fatty acids and glycerol, the complete reaction consisting of three consecutive bi-molecular reactions which are interdependent, though not necessarily taking place at the same rate. The author emphasised the fact that as industrial saponification involves a heterogeneous system, it might well be that physical considerations outweigh purely chemical ones, and experimental facts were quoted in support of this view. It is important to realise that as saponification resolves itself ultimately into a reaction between molecules of a triglyceride and of water, three possibilities are open, viz., (a) reaction in the oil phase, (b) reaction in the aqueous phase, (c) reaction in the surface of contact between the two phases; and Treub has shown that it is the third possibility which supplies the clue to the operation. The importance of emulsification in saponification is made apparent from the circumstance that in an emulsion, the velocity of the reaction which takes place at the surface of contact of the two phases, depends on the magnitude of this surface; anything which increases this surface, i.e., diminishes the surface tension between the fatty matter and the aqueous solution, accelerates the reaction. From this aspect, the function of the particular reagents used technically in the acid, autoclave, Twitchell and fermentation methods of saponification, respectively, becomes apparent.

The importance of the time factor in saponification was then dwelt upon, reference being made to the conflicting views of different investigators, some of whom concluded that all oils and fats are saponified at the same rate, and others that the glycerides of the fatty acids are more easily hydrolysed the higher the molecular weight of the fatty acids. The author pointed out, however, that as most of the experiments were carried out in

homogeneous solution, they may have little bearing on industrial saponification. A summary was given of previous industrial investigations on the rate and extent of the hydrolysis of different oils and fats, but as the conditions differed considerably no definite conclusions could be drawn. The author then described his own large-scale experiments on the rate and extent of saponification, by the autoclave process, of tallow, palm oil, linseed oil, palm-kernel acid oil, Nos. 1, 2, and 3 whale oils, lime and magnesia being used as the splitting bases. In all cases a constant steam pressure of 8 atm., a charge of 3 tons of oil or fat, an amount of base equal to 2½ per cent. of the weight of oil, and a period of treatment of 10 hours, were employed, the course of the reaction being followed by the withdrawal and testing of samples hourly. The results obtained were shown in a series of curves, which are of the exponential type, being characterised by a slow initial stage followed by a rapid second stage, when about 90 per cent. of the oil is split in the first 4 hours, after which the rate of reduction is much retarded. Magnesia was the most effective base for tallows, palm-kernel acid oil and the whale oils, lime being superior for palm oil, but with linseed oil the rate and extent of hydrolysis were identical for each base. Using magnesia as the base, tallows were hydrolysed most quickly, and in decreasing order come whale oils, linseed oil, palm oil and palmkernel oil. Beef tallow hydrolyses much more quickly with magnesia than mutton tallow. In the case of the whale oils, whichever base is used, the rate of hydrolysis is in the order No. 1, No. 2 and No. 3, No. 1 giving the highest value. Lastly, the author submitted in tabular form numerical details of the average extent of hydrolysis of various oils and fats after treatment with lime and magnesia, respectively, for 8 hours under the conditions outlined above. These averages are compiled from the working of 625 3-ton charges. It appears that a split of upwards of 98 per cent. was obtained with tallow and 92 per cent. with linseed oil.

NOTTINGHAM

On December 13, Mr. S. F. Burford presiding, Prof. H. E. Armstrong gave an address on "Legislative and Departmental Interference with Industry and the Common Weal."

The future of chemistry in England, and the welfare of an industrial population greater than the country can carry depend upon the extent to which chemists are mastered by the idea of their solidarity, and insist on being represented on all bodies dealing with questions in which chemistry is involved. By an abuse of the Food Acts, the lowering of the quality of milk has been allowed to continue unchecked for fifty years. The Act providing for the sterilisation of milk by heating was passed with insufficient knowledge, but evidence is accumulating that the new dangers so introduced are greater than those which were to be removed in this manner. The bureaucrat and the sentimentalist are trying to deprive us of our most effective paint. This is clearly shown by the inner history of the Home Office inquiries and of the proceedings of the International Labour Conference last year.

The inquiries into the smoke nuisance were entrusted to technically unqualified persons, who

concentrated on a totally unnecessary proof of the nuisance and almost neglected the question of low-temperature carbonisation. Private persons of vision and imagination have investigated this problem with a success that will never be attained by H.M. Fuel Research Board. The Safeguarding of Industries Act is a most unhappy example of lack of clear thinking. The chief, if not the only, gainers are the members of the legal fraternity. Chemists should protest against the shameful way in which the traditions of their craft have been treated. The whole lists should now be put in order by competent advisers. In the dyestuffs industry the first condition of success is direction by persons who understand. No general in the army, however distinguished, can lead the attack on dyestuffs.

In the matter of research freedom of action, which is as much the right of scientific investigators as of artists and poets, is being threatened by a bureaucratic body, largely in the hands of literary men. This has displaced the Royal Society, which has made no attempt to influence the public, as it did in the days of Faraday.

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REPRESENTATIVES ON OUTSIDE BODIES, 1922-23

Federal Council for Pure and Applied Chemistry: F. H. Carr, Dr. S. Miall, and W. J. U. Woolcock.

National Physical Laboratory (General Board): Sir W. J. Pope and Prof. F. G. Donnan.

Institute of Chemistry Standards Committee: Dr. A. Holt, Prof. A. R. Ling, and Mr. W. G. Wagner.

British Engineering Standards Association: Aircraft Sub-Committee on Chemicals: Prof. W. A. Bone. Sub-Committee on Textiles: Mr. C. F. Cross. Sub-Committee on Dopes: Dr. J. N. Goldsmith.

Imperial Mineral Resources Bureau: Lead, Silver, Zinc, and Cadmium Sub-Committee: Mr. H. M. Ridge. Aluminium, Magnesium, Potassium and Sodium Sub-Committee: Dr. R. Seligman. Minor Metals Sub-Committee: Mr. W. G. Wagner. Publications and Libraries Sub-Committee: Mr. W. J. A. Butterfield. Abstracts Sub-Committee: Prof. H. Louis and Mr. T. F. Burton. Chemical Industries Sub-Committee: Mr. C. S. Garland.

British Empire Sugar Research Association: Prof. A. R. Ling and J. W. Macdonald.

Committee on "Tests of Graduated Glassware": J. L. Baker, F. H. Carr and Dr. B. Dyer.

Governing Board of Imperial College of Science and Technology: Sir W. Pearce.

Sectional Committee of Chemical Engineering of the British Engineering Standards Association: C. J. Goodwin, J. A. Reavell, C. S. Garland and Dr. W. R. Ormandy.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF PUBLIC ANALYSTS

Mr. P. A. Ellis Richards presided at the meeting held in the Chemical Society's Rooms on December 6, when the following papers were presented.

A note on the estimation of formaldehyde and acetaldehyde, by Messrs. E. W. Blair and T. S. Wheeler, stated that in investigating the action of oxygen and ozone on various hydrocarbons, the authors had had to devise accurate methods of analysing solutions containing mixtures of (a) formaldehyde and acetaldehyde, and (b) formaldehyde, hydrogen peroxide, formic acid, with a trace of ozone. For (a), satisfactory results were obtained by estimating the total aldehydes by Ripper's bisulphite method (*Monat. für Chem.*, 21, 1079) and the formaldehyde by the cyanide method. For (b), the components were estimated *separately*, the formic acid with *N*/100 alkali, ozone with neutral potassium iodide, hydrogen peroxide by Kingzett's method (*Analyst*, 9, 6), and formaldehyde by Romijn's method.

Mr. H. A. Peacock has found that sulphur dioxide may be absorbed by cattle cakes and meals during fumigation, but that it disappears after about a week. Therefore any harmful effect ascribed to the consumption by stock of such cakes is not due to sulphur dioxide. The amount absorbed was found to depend on the variety of cake, the harder cakes absorbing less than the softer, and on its physical condition, *i.e.*, whether in block or powder form.

Mr. C. H. D. Clark described a sliding scale designed to assist in titrating strong solutions against weaker standards by dilution and measurement of a known volume. The scale, which is easily made and set in positions depending on the dilution, indicates what alternative dilutions are available in any particular case, in order that a convenient burette-reading may be obtained at the end of the process.

Some notes on the unsaponifiable matter of fats were presented by Mr. D. W. Stewart, who dealt with the difficulty of deciding whether a margarine containing no coconut, palm kernel or butter fat is made of true animal fat, or whether it contains palm oil or hardened vegetable oil. The amount of sterol in the unsaponifiable matter and the melting-point of the sterol acetate do not give the information desired. The proportion of sterol in the unsaponifiable matter varies from 48 per cent. in maize oil to 7 per cent. in palm oil, and from 38 per cent. in lard to 9 per cent. in hardened whale oil. Highly hardened fats still contain sterol. The cholesterol acetate of animal fats melts at 114°-114.5° C., and the phytosterol

acetate of vegetable fats is a mixture, of which a fraction melts at 125° C. or higher, but some pure vegetable oils yield a fraction melting about 114° C.

In a note on the sulphuric-acid test for fish-liver oils, Messrs. N. Evers and H. J. Foster show that the sensitiveness of this test is greatly increased by adding natural oils (e.g., olive, arachis, lard oils, tallow) which do not give a colour reaction. Oxidation of the oils destroys this power, but it is unaffected by hydrogenation. The active substance is not cholesterol or phytosterol, and it is not present in commercial oleic or stearic acids, mono- or di-glycerides. The brown coloration produced by sulphuric acid with liver oils, after oxidation, is also intensified by the addition of natural oils.

BRITISH LEATHER MANUFACTURERS' RESEARCH ASSOCIATION

Following the third annual general meeting of the Association, held on December 7, Dr. R. H. Pickard, director of research, gave a lecture on the work of the Association in the large hall of the Leathersellers' Company. The lecture was open to all members of the trade and was attended by members of the Association and a large number of others. Mr. J. H. Williams, Worshipful Master of the Leathersellers' Company, presided, and in opening the proceedings emphasised the importance of research to the industry. Col. W. E. Walker, chairman of the Association, explained that the results of research were, of course, the property of the members, but that this meeting had been arranged to increase the interest of the trade in the Association.

Dr. Pickard commenced by paying a tribute to the work of Prof. H. R. Procter, to whom was practically due the creation of the science of leather manufacture. Some tanners were at present wondering whether they could afford to join the Association; it would soon become apparent that they could not afford to remain outside. The policy of the Association had been to study fundamental principles, and he believed that they had now reached the point at which the laboratory results were capable of being translated into works practice. As an example, they had started to investigate the composition of the actual chrome-tanning agent. Initially, he had been told that this was not likely to interest the tanners and, moreover, was already being done in America. They were still trying to do it in America. He and his staff were now hot upon the trail of the actual chrome-tanning agent, and incidentally believed that they had discovered one of the main causes of, and probably the means of preventing, the occurrence of a very important trouble in chrome-tanning, namely "spue." After referring to some common misconceptions in the trade, Dr. Pickard exhibited a remarkable series of lantern slides, showing the effects on the arrangement and structure of the fibres in goat, ox, and sheep skins of various swelling, plumping, and depilatory agents; and by means of a projection microscope he demonstrated the swelling of single fibres in acid and other liquors.

Mr. J. Turney Wood said that the lecture had been a revelation to most of them. If there was any part of the work of the Association which tanners could not understand they should employ a chemist who could. Dr. Gordon Parker congratu-

lated Dr. Pickard on the work generally and on the magnificent lantern slides. Mr. Seymour Jones proposed a vote of thanks to Dr. Pickard and his staff for their valuable work, and this was seconded by Mr. E. D. Evans, president of the United Tanners' Federation.

THE BIOCHEMICAL SOCIETY

A meeting was held in the Biochemical Department, Institute of Physiology, University College, London, on December 11. Prof. J. C. Drummond occupied the chair and the following papers were communicated.

"Cod-liver Oil in the Winter Feeding of Milch Cows," by J. C. Drummond, J. Golding, J. Mackintosh, S. S. Silva and K. H. Coward.

Further confirmation was brought forward of the fact that the amount of vitamin A in cow's milk is largely determined by the diet of the animal. In an experimental group of cows brought in to stall under winter conditions and fed on a typical winter ration of roots, hay and concentrates deficient in vitamin A, the milk secreted soon showed a marked falling off in vitamin content. It was found possible to raise the amount of vitamin A in the milk very considerably by giving the animals a small supplement of cod-liver oil of high potency daily. As little as 2 oz. per day was highly effective. Amounts up to 4 oz. per day were given without any evidence being obtained that the taste or flavour of the milk or butter were affected, but it is advisable to employ only oils of high grade. Cows permitted to have limited access to pasture during the winter show a gradual improvement in the vitamin-A value of their milk as the spring advances and the pasturage freshens.

"The Chemistry of the Vitamin-A Fraction of Cod-Liver Oil," by J. C. Drummond and K. H. Coward.

The vitamin A can be almost quantitatively transferred to the unsaponifiable fraction of highly potent fish-liver oils if precautions are taken to prevent oxidative changes. The only crystalline substance which has been isolated from this fraction with certainty is cholesterol, which constituted about 35 per cent. of the fraction in the case of the sample of oil examined. The whole of the cholesterol may be removed by crystallisation from methyl alcohol and precipitation with digitonin, leaving the physiological activity wholly in the filtrate. Small traces of another crystalline material have been obtained from the cholesterol-free residue but in an amount too small for identification or growth tests. Benzoylation, acetylation and bromination of the unsaponifiable fraction yielded only the derivatives of cholesterol. From the filtrates, which retained the activity, no further crystalline substances could be obtained. There was no evidence of the presence of hydrocarbons of the spinaene type nor of ketonic or aldehydic substances. Incomplete removal of the lipochrome pigment did not appear to lessen the activity of the fraction, so that it is improbable that the active substance is of this class. No confirmation of Iscovesco's work on the association of the active substance with a substance of the lecithin type could be obtained. Many highly active oils gave no precipitate by following his technique. The active fraction, if prepared from a high grade oil, is free from nitrogen, iodine, sulphur and phosphorus. Attempts to separate the potent substance by steam

distillation, super-heated steam or high vacuum distillations of the unsaponifiable matter demonstrated that this substance is volatile under these conditions but no sharp separation was obtained. In most cases there was a considerable loss in spite of all operations being carried out in a vacuum or an inert atmosphere. Fractional crystallisation from numerous solvents only yielded cholesterol with concentration of the vitamin in the mother liquors.

THE PHYSICAL SOCIETY

At the meeting held on December 8, a paper on "The Relation between Molecular and Crystal Symmetry as shown by X-ray Crystal Analysis" was read by Mr. G. Shearer. After a discussion of the nature of the elementary crystal lattice, a table was given showing the number of asymmetric molecules per unit lattice necessary to produce the symmetry of the various crystal classes, thirty-two in number. These range from 1 in the case of the triclinic asymmetric class to 48 in the case of crystals of the hexakisoctahedral class. The existence of fewer molecules than the "symmetry number" in the unit cell implies the existence of symmetry in the molecule itself. Only certain positions of the variously oriented molecules in the crystal lattice are possible. Supposing that the minimum material necessary to satisfy the symmetry conditions is employed in building crystals, it follows that each unit cell contains one and one only of each differently oriented molecule. There is considerable evidence to show that certain molecules possess symmetry which, in crystal building, is shared with the crystal. Thus the fact that naphthalene and anthracene form monoclinic crystals with two instead of four molecules in the unit cell implies that each of these molecules possesses a two-fold symmetry. Such symmetry is destroyed by the addition of an OH-group to one side of the naphthalene molecule. Similarly, the addition of COOH and other groups to the benzene molecule, as in benzoic, salicylic and phthalic acids, which form monoclinic prismatic crystals having four molecules to the cell, destroys the symmetry of the benzene molecule. The symmetry of the benzene molecule is found to be fourfold, consisting possibly of a plane of symmetry and a diagonal axis perpendicular to the plane. Neither the Kekulé nor the Claus structural formula for benzene satisfies this condition. The formulæ of Ladenburg and Dewar, respectively, conform with the condition.

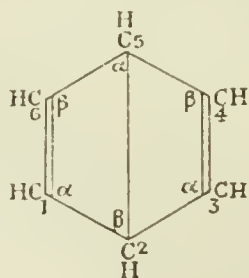


Fig. 1

Dewar's formula is shown in Fig. 1, and much chemical evidence in support of its validity has recently been advanced by Ingold. If the structure is a puckered hexagon, as suggested by Bragg, the points α lying above, and those marked β lying

below the mean plane of the ring, it is found that the molecule has the required symmetry. X-ray analysis shows that the naphthalene molecule has a two-fold symmetry—probably a centre of symmetry. All formulæ hitherto proposed for naphthalene appear to possess too great symmetry. Structural formulæ 2a and 2b satisfy the symmetry requirements of the naphthalene molecule.



Fig. 2A

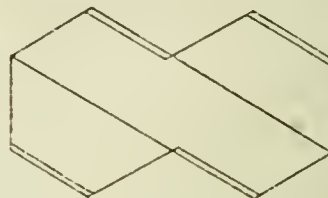


Fig. 2B

The structure of anthracene is shown in Fig 3. Among inorganic compounds, the results of X-ray analysis and the theory developed in the present paper were applied to determining the molecular structure of ruby, silica, ice, sodium and potassium chlorides, calcium carbonate, sodium nitrate and sodium chlorate. It was shown that if the molecule of sodium chloride actually exists, the sodium atom to which any particular chlorine atom belongs is not one of the six surrounding it at equal distances, but one of the sodium atoms disposed diagonally relative to the chlorine. In any case, molecular models having the requisite symmetry can be constructed by consideration of the distribution of electrons round the atomic nuclei. Finally, the factors underlying the selection by a molecule of some particular crystal class were briefly discussed.

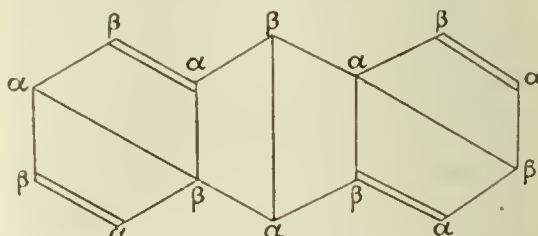


Fig. 3

A paper on "A Modification of the Powder Method of Determining the Structure of Metal Crystals" was submitted by Dr. E. A. Owen and Mr. G. D. Preston. Instead of being reduced to a powder, the metal to be investigated is subjected to heat treatment necessary to produce throughout its volume a mass of crystals about 1 mm. or less in size; the plate is etched to remove the deformed surface layer of crystals or oxide, and is smeared with vaseline to prevent further oxidation. The plate of metal is then mounted on the X-ray spectro-

meter and its structure investigated by the ionisation method devised by Bragg. Crystal structures of aluminium, copper and lead are derived from the face-centred cube, iron from the centred cube. The values of the length of the side of the elementary cube were found to be respectively 4.041, 3.623, 4.983 and 2.869 Ångström units. Magnesium possesses a hexagonal lattice of the close-packed type. The length of the side of the hexagon is 3.17, and the axial ratio 1.631 Ångström units.

Dr. A. B. Wood submitted a paper on "The Cathode-ray Oscillograph." The instrument is a robust form of oscillograph of the type used by Sir J. J. Thomson and D. A. Keys in the application of piezo-electricity to the measurement of high pressures and is adapted for commercial production. Photographic records are best obtained by action of the cathode rays upon Schumann plates containing a proportion of calcium tungstate, a type of plate previously employed for X-ray purposes by Levy, West and Baker. A visible photographic impression is obtained on Schumann plates when the velocity of the beam across the plate is as great as 1000 metres per second. A further increase in sensitivity of the plates is desirable.

A low-voltage form of cathode-ray oscillograph was exhibited by the Western Electrical Company.

THE CHEMICAL SOCIETY

The ordinary meeting, held on December 7, was presided over by Prof. S. Smiles. Prof. A. Smits, of Amsterdam, attended the proceedings.

The papers read were as follows:—(1) "The Iso-Electric Condition of Gelatin": S. O. Rawling and W. Clark. (2) "Studies on Metal Hydrides: the electrolytic formation of stibine in sulphuric acid and caustic soda solutions": H. J. S. Sand, E. J. Weeks and S. W. Morrell. (3) "Three-carbon Tautomerism in the Cyclopropane Series": F. Goss, C. K. Ingold and J. F. Thorpe.

(1) According to the latest theory, gelatin possesses the formula $HX.OH$, where X is a large complex which may undergo ionisation in the following two ways:— $HX'+OH'+HX.OH \rightarrow H'+XOH'$. In the case of gelatin the left hand and right hand reactions become equal at the iso-electric point. The P_H value of gelatin at the iso-electric point was found to be 4.7, and at this point certain physical properties have a maximum and others a minimum value. The authors have studied the relationship between minimum viscosity and the presence, in increasing quantities, of sulphuric and acetic acids.

(2) Dr. Sand dealt with the relationships between the yield of stibine in caustic soda and sulphuric acid solutions, and overvoltage and current density, the yield being measured by passing through silver nitrate solution.

(3) Dr. Ingold, in an interesting paper, adduced evidence which pointed to a possible new form of isomerism.

The three papers, concerned respectively with the debatable subjects of the constitution of gelatin, overvoltage, and isomerism, gave rise to good discussions.

On December 14, in the Institution of Mechanical Engineers, Prof. C. H. Desch lectured on "The Metallurgical Applications of Physical Chemistry."

CORRIGENDUM.—In the issue for December 15, page 519 R, line 2, delete "Louis."

PERSONALIA

Prof. A. Mailhe, of Toulouse, has been appointed to the Chair of Liquid Fuels in the University of Paris.

Mr. T. Edward Lescher has been appointed managing director of Evans Sons, Lescher and Webb, Ltd., drug manufacturers, of Liverpool and London.

Dr. H. Plauson, the inventor of the Plauson mill, etc., has been appointed professor by the Government of Esthonia for his researches in colloid chemistry, and in particular for his work on the utilisation of oil-shales.

Dr. Anthony McGill, Chief Analyst and Head of the laboratories of the Department of Health of the Dominion Government, Ottawa, has retired, upon superannuation. He has been chief analyst for 17 years and in the Government service for 35 years.

The following have been nominated executive members of the Italian Government Commission on Chemical Industry:—Prince Ginori Conti, president; Prof. Nasini, vice-president; Prof. Serono, treasurer; and Professors Paternò and Villavecchia.

Other official appointments announced from Italy are:—Prof. D. Girasoli to be professor of chemistry in the Royal Industrial Instituto of Reggio Calabria; Prof. A. do Dominicis to the chair of agricultural chemistry in the Royal Agricultural High School at Portici; and Professors M. Betti, G. Dacomo, and P. Spica have been appointed directors of the schools of pharmacy in the Universities of Genoa, Modena, and Padua, respectively.

Dr. E. H. Tripp, who has edited the "Review" section of this *Journal* since its inception 5½ years ago, is retiring from the Society's service at the end of the year, when that section will be replaced by the new weekly periodical "Chemistry and Industry." Dr. Stephen Miall, who will edit the new venture, assisted by Mr. G. H. Ford, was formerly a practising solicitor and is now chairman of the Brimsdown Lead Co., Ltd., a position which he will retain.

The following appointments are announced from Germany and Austria:—Prof. E. Müller, director of the electrochemical laboratory in the Technical *Hochschule*, Aachen; Dr. F. Straus, professor of chemistry in the Technical *Hochschule*, Breslau; Professor Börnstein, to the chair of fuel chemistry in the Technical *Hochschule*, Charlottenburg; Dr. J. Eggert, to the chair of physical chemistry in the University of Griefswald. Dr. H. Suida has been appointed professor of organic chemical technology in the Technical *Hochschule* of Vienna, and Prof. Dr. Fuhrmann to the chair of technical mycology and food chemistry in the corresponding institute at Graz.

* * *

Among the deaths recently announced on the Continent are those of Prof. F. P. A. Barbier, a pupil of Berthelot, at the age of 75 years; of Prof. August Horstmann, one of the earliest workers in the field of thermochemistry, aged 80 years; and of Dr. C. von Martius, formerly chemist to the Osmose Gesellschaft and managing director of the A.-G. für Anilin-Fabrikation, Berlin.

CORRESPONDENCE

THE "REVIEW"

The subjoined correspondence has been received by the Editor for publication in the last issue of the "Review." In one or two cases, the letters and messages have had to be condensed slightly, owing to pressure on our space. The Review Editor wishes to take this opportunity to thank not only those who have communicated with him on this occasion, but also the many friends and contributors at home, in the Overseas Dominions, and in foreign countries who have helped to make the "Review" the success which our correspondents claim it to be. He would like especially to thank Dr. Charles A. Keane, for several years chairman of the Review Committee, Mr. W. J. A. Butterfield, Dr. Charles Carpenter, and other members of that Committee for much helpful advice and criticism received, particularly in the early days of the "Review."

From DR. R. F. RUTTAN, Professor of Chemistry, McGill University, Montreal, and President of the Society in 1921-22:—

I saw, with great regret, in the minutes of the Council of the Society of November 13, which only reached me on December 1, that you were severing your connexion with the Editorial Staff of the *Journal*.

The "Review," which you have developed to such a high degree of interest and importance during the past five years, has always been the attractive portion of the *Journal* to the Canadian members of the Society. It must be a satisfaction to you to have the Council recognise your efforts by converting it into a weekly publication. Wishing the new venture of the Society every success . . .

From PROF. E. C. C. BALY, F.R.S., Professor of Chemistry in the University of Liverpool:—

I most cordially wish success to the new venture of the Society of Chemical Industry in issuing the "Review" as a weekly publication. There is no question but that the "Review" has fully justified its existence since its inception a few years ago. As time progressed it was felt by many of us that the old *Journal* did not entirely meet the needs of the day, and that the aims and objects of the Society were not fully served. The decision of the Council to issue the "Review" was a wise one, and the new *Journal* was most enthusiastically welcomed on all sides. Under the direction of its editor, Dr. Tripp, it has steadily consolidated its position, and it now occupies a very high position among the chemical industrial journals of to-day. The weekly publication of the "Review" under its present standard of excellence will certainly be a landmark in the Society of Chemical Industry, and its success cannot but enhance the reputation of the Society.

From PROF. A. R. LING, Professor of Biochemistry, University of Birmingham:—

I consider that during the past five years the "Review" has been a most valuable supplement to the *Journal* of the Society of Chemical Industry. The promises that were made in the leading article

printed on page 1 of the first number of the "Review" in 1918 have been fulfilled in every way, and I learn of the "Review" Editor's retirement with great regret.

From DR. H. E. HOWE, Editor of the *Journal of Industrial and Engineering Chemistry*:—

Believing as I do in the importance of publishing scientific information of all kinds, and holding that one of our most important functions is quickly to advise research men of the accomplishments of their fellows, I cannot do otherwise than applaud the Society of Chemical Industry upon its decision to issue a weekly under the title of "Chemistry and Industry."

At the same time it will be something of a loss no longer to find the "Review" in the *Journal* of the Society. We have come to look upon this section as one of much value to us, particularly as regards many fields of work in Great Britain and other parts of the world. The "Abstracts" have been most helpful, the "Transactions" are always read with interest, and the reports of foreign meetings are particularly helpful. The place which the "Review" section has won sets something of a high mark which, to be surpassed by the weekly, will require an unusual amount of hard work and persistent effort.

From W. J. A. BUTTERFIELD, Esq., M.A., Gas Referee, London:—

I desire to put on record my appreciation of the signal service which the "Review" section of the Society's *Journal* has rendered to chemists and chemical industry during the five years of its existence, and at the same time to express my deep regret that it is no longer to be issued as such. In its early years I think no member of the Publication Committee devoted more time to the "Review" than I did, and I much regretted that my association with it was severed through my resignation of membership of the Council and Publication Committee on account of my disapproval of the policy of the Council. I believe that the "Review" will stand as a model of a succinct record of current affairs in chemical industry, and will be more valued for reference in the future than the more cumbersome reports of the weekly technical press. You, Sir, are to be warmly congratulated on your five years' work, much of it done in times of great difficulty, as Editor of the "Review."

From MR. E. GRANT HOOPER, late Deputy Government Chemist:—

I was originally opposed to the establishment of the "Review," as I thought that everything necessary and desirable by way of addition could have been inserted in the "Transactions" and "Abstracts" at a minimum cost to the members of the Society. I feel bound to say, however, that the "Review" has most successfully and most usefully cultivated a field previously somewhat neglected and occasionally contemned. The subjects treated have covered a wide range; the matter has appeared timely; the presentation has been generally attractive; and attention has been promptly called to all new work. I have myself found the "Review" most interesting, though as a busy man I had previously demanded useful, rather than merely attractive matter. I am sure that a great many

members of the Society feel as I do, and I offer you both thanks for what we have received and congratulations on the success of your work.

From MR. W. T. BURGESS, F.I.C., Water Analyst and Consulting Chemist, London:—

It is with much regret that I learn from the last number of the *Journal* that the present arrangement of publishing the "Review" fortnightly is to be discontinued. I do not subscribe to any of the trade journals, and the information under the various headings in the "Review" kept me in touch with the state of chemical affairs, both at home and abroad, at sufficiently frequent intervals.

From SIR EDWARD THORPE, C.B., F.R.S., President of the Society in 1894-95:—

It is news to me that the "Review" is to cease publication at the end of this year, and that your editorship terminates with it. I am very sorry to gather that your connexion with the Society's publication comes to an end. I know nothing of the inner working of the *Journal*, but my general impression, as derived from a constant perusal of the *Journal* itself, was that it was eminently satisfactory. The *Journal* appeared with unfailing regularity and the editorial business, as it was conducted, left nothing to be desired. The issue of the *Journal* weekly is an experiment which I shall watch with interest.

From PROF. ARTHUR SMITHELLS, C.M.G., F.R.S., retiring Professor of Chemistry in the University, Leeds:—

The addition of the "Review" section to the *Journal* seems to me to have achieved something like the transformation of an automaton into a living being. I say this with all respect to old friends, who brought the *Journal* into being and showed so much solicitude and discretion in establishing its impartiality and its security from caprice. I do not think that these essential elements have been impaired in the slightest degree by the change which has taken place, whilst the interest of the *Journal* has been increased beyond measure. I should like to join in what I am sure will be a chorus of congratulation to the "Review" Editor on the great skill and judgment with which he has carried out a most valuable reform.

From PROF. A. G. PERKIN, F.R.S., Professor of Colour Chemistry and Dyeing in the University of Leeds:—

I was originally an opponent of the addition to the *Journal* of a "Review" section. I feared that the extra expense incurred by such an extension, and which appeared to be hardly necessary, would injure the circulation of the *Journal*, and also that the additional work in conjunction therewith might detract from the attention given to its other very important sections. I am happy, however, to own that my apprehensions have proved to be groundless, and as a constant reader of the "Review" I now consider this to be a valuable addition to the *Journal*, and of service to myself.

From PRINCIPAL J. C. IRVINE, F.R.S., Principal of the University, St. Andrews:—

With many others, I regret the passing of the "Review." This section of the Society's activities served a useful purpose and added to the value of

the *Journal* by the inclusion of subjects possessing a real human interest. Our President, who yields to no one in his appreciation of what a chemist ought to be, sounded a true note when he reminded us recently that we must not content ourselves by being merely chemists, and I believe the "Review" has been a factor in securing this end. At least it has prevented some of us from remaining merely academic chemists, and the "Review" Editor has earned the gratitude of those who have to look out on the busy world of chemical industry from the seclusion of the Professor's Chair.

From COLONEL SIR EDWARD BROTHERTON, Leeds:—

I have always looked to the "Review" section of the *Journal* to give me some general acquaintance with movements in the chemical trade in various parts of the world, as well as to present me with valuable information respecting the latest publications in chemical literature. I am, therefore, sorry that this section of the *Journal* is not to appear after the end of the present year in its present form.

From PROF. T. PHILLIPS BEDSON, late Professor of Chemistry in the Armstrong College, Newcastle-on-Tyne:—

So we are to have a change in the *Journal*. Changes come, but improvement lingers. It is much to be regretted that this change is coincident with the loss of the services of the "Review" Editor, in whose skilful hands it has been created, and has grown from month to month to be the feature which, by the interest of its articles and the information supplied, has procured a circle of constant readers of the *Journal*—the great asset of the Society. To the "Review" Editor are the members greatly indebted, and all will join in expressing their regrets at the severance about to take place, and all are grateful to him for the able manner in which he has contributed to the success of the venture.

From DR. W. R. ORMANDY, London:—

In the last issue of the *Journal*, I noted with great regret that Dr. Tripp would shortly be ceasing to work as "Review" Editor; I am one of the many who appreciate very highly the wonderful improvement in the *Journal* that has taken place since his connexion therewith. To those of us who are interested in the world-wide ramifications of the chemical industry, but have not time to read up the subject, the "Review" has proved of the greatest value and interest. I should not like Dr. Tripp's connexion with the *Journal* to cease without taking an opportunity of expressing appreciation of his past services, and regret that he has found it necessary to sever that connexion.

From DR. THOMAS R. DUGGAN, of New York:—

It is with regret I notice that the "Review" Section of the *Journal* is to be discontinued, and think I am voicing the view of my American friends in this statement, that ever since its commencement it has been one of the great features of the *Journal*. Most of us are busy people and can usually turn to the "Review" to find matters of interest without wading through some dozen or so of other journals, knowing that the matter is sound, otherwise the Editor would not have passed it. I sincerely hope that with the new form of *Journal*, the "Review" will not be entirely overlooked.

SAFEGUARDING OF INDUSTRIES ACT

SIR,—Now that the opposition to the Safeguarding of Industries Act is dying down somewhat, one may perhaps be allowed to inquire where things went wrong from the chemical standpoint, for there is no doubt that chemists as a body have not covered themselves with glory in their appearances before the Referee. Much has been learned from these hearings, but much remains to be learned, not only by the individuals concerned, but by the profession as a whole.

Some are beginning to appreciate the difficulties in combating nonsense (especially scientific nonsense) before a lay tribunal, especially when it has to be done through the medium of words, often of uncertain meaning. Some are beginning to realise after all that chemical merchandising is apparently the important thing in chemical industry; so very useful when the enemy was at the gate, and our men dying by thousands for want of proper support in the factory line! Some have not yet recovered from the shock of realising that what "So-and-so" wrote in '92 is necessarily of far greater moment than the dictates of common sense to-day. And some have realised that chemists have failed in their public duty, and are not a little worried as to what is to be done about it. Reference is particularly made to those chemists who are in contact with the industrial world (though who amongst us is without blame?), for upon them rests the honour of upholding the profession of chemistry in the public mind. When they fail we all suffer, and it is difficult to see how the position can be improved until all chemists indulge in some good plain thinking. At Leeds, on November 22 last, Mr. F. W. Richardson spoke very plainly to the Institute of Chemistry on the subject of unprofessional conduct and the ethics of expert evidence. He said that they needed some special permanent committee to deal with unprofessional conduct. He reminded his hearers of the low estimate in which expert evidence was held—particularly in the legal profession—and he pleaded for the oath, "The truth, the whole truth, and nothing but the truth," in giving expert evidence. Mr. Richardson is right, and I trust that a leader will arise to see the matter through.

It is granted that many chemists have been drawn into these disputes under conditions wholly alien to the spirit of their science. It is appreciated that they have been misunderstood, but it is their duty to make themselves understood. Technical things can be explained, and non-technical people can be made to understand them, but not when the superior "take it or leave it" attitude is adopted. So long as the legislature must deal in technical matters, and must appoint non-technical lawyers to deliver technical judgments, then it is the duty of the professional societies, as well as the individual chemists concerned, to appoint themselves advisers to the lay mind without fear or favour except for the truth. Too often the appearance of expert chemists for opposite sides in a dispute has been as unseemly and just about as useful as would be the spectacle of the Archbishops of Canterbury and York discussing the doctrine of transubstantiation at a meeting of the L.C.C. Is it surprising that the lay mind cancels them out? When chemists appear in public, above all things let them appear for chemistry.

To chemists it is obvious that there is much less between the views expressed by different chemists than is appreciated by the non-technical person who neither knows nor understands the subtlety of chemistry. But we ought not to air our petty differences except in debate in the privacy of our own societies. If there is uncertainty as to the meaning to be given to the terms which form the basis of the chemist's work, then surely the appropriate societies can do good work by initiating thought and discussions on the subject, if they do not go further and stabilise the views to be put forward for consumption by the public. Surely if quasi-scientific definitions of technical terms can evolve from a squabble between conflicting trade interests (and where interests clash opinions are bound to differ) before a non-technical lawyer, there is surely hope that chemistry may show a sufficiently united front to do a little better.

No one apparently can influence the present Act or its administration, but we ought at least to be prepared for the future. Why should not the Society of Chemical Industry, as being the appropriate Society to connect chemistry with the world of industry, develop functions akin to those of the British Engineering Standards Association, and have its precepts embodied as a glossary in the preamble to any future Acts of Parliament affecting chemistry. We should all, chemists and lawyers alike, know then that we were at least talking about the same thing.

Surely the Geneva Conference on Nomenclature did good work for academic chemistry and provided something of a parallel to the present need for precision in industrial chemistry.

However, such a suggestion may be too venturesome, but I do fervently hope that the societies may do something so that in the near future when British chemists have dealings with the outside world, whether it be the law or public generally, they may be helped to place their professional appearances on a higher plane than obtains to-day. The profession of chemistry is worthy of being respected and feared; its members should not be merely figures who have their say and cancel out.—I am, Sir, etc.,

L. A. JORDAN.

Manningtree, Essex.

December 14, 1922.

LEGAL INTELLIGENCE

ARSENIC IN COCOA

On December 18, in the Richmond Police Court, the Home and Colonial Stores, Ltd., and Messrs. Rowntree and Co., York, were summoned by the Surrey County Council under the Sale of Foods and Drugs Act, 1875, for selling, and aiding and abetting the sale, respectively, of cocoa containing white arsenic to the extent of one-fortieth of a grain per pound. Both defendants pleaded guilty, and Messrs. Rowntree took absolute responsibility for the position in which the Home and Colonial Stores had been placed.

For Messrs. Rowntree it was stated that the most competent scientific opinion held that the cocoa in question would not endanger the health of those who drank it; and that the contamination was an accident which might have happened to any manufacturer of a foodstuff. Last July it was discovered

that some of the cocoa the firm had been making contained faint traces of arsenic, which, after immediate and intensive search, was found to be present in the potassium carbonate used in the manufacture. Immediately the whole of the cocoa left in stock—some 300 tons, valued at £100—£250 a ton—was sacrificed, but it was held to be useless to attempt to get back what had already been sold to the trade. The Home and Colonial Stores had destroyed 85 tons of the material, worth about £1200. Sir William Willcox, medical adviser to the Home Office, stated that this was the first instance he had heard of in which arsenic had got into a food through potassium carbonate.

The Home and Colonial Stores, Ltd., was fined 40s. and Messrs. Rowntree £20, with 50 guineas costs.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The plant erected at Bully by the Compagnie des Mines de Béthune to produce synthetic ammonia by the Claudo process is now working successfully. By this process 45 to 50 per cent. of the hydrogen in coke-oven gas is separated by liquefaction at the very low cost of 0.50 francs per cb. m. The synthetic ammonia produced is converted into ammonium sulphate and the coke-oven gas from which the hydrogen has been extracted is used as a source of heat and power. So good have been the results obtained that the Sociétés des Mines de Lens et d'Aniche have also decided to erect a plant. If the process comes into extended use, the increased output of ammonium sulphate will affect the fertiliser market, especially if the State powder factory at Toulouse is transformed into a large synthetic-ammonia plant, as is contemplated. Experiments are being conducted with the new fertiliser, "phosphazote" (cf. J., 1922, 390 n), which is expected to cost less to manufacture than superphosphate.

The paper industry is greatly concerned about the enormous increase of imports of paper and paper pulp from Canada, Scandinavia, Finland, Germany, Belgium and Switzerland. Imports of mechanical and chemical pulp during the first nine months of 1922 amounted to 1,680,459 metric tons, compared with 154,069 t. for the whole of 1921. The reason for this large increase lies in the shortage of timber in France, due to the destruction of forests during the war and the great consumption of timber for reconstruction in the devastated areas. Before long the Government will have to consider the question of re-afforestation, and there appears to be no reason why France should not become an important producer of paper, especially as she is as well supplied with water power as is Sweden.

The question of substituting alcohol for petrol as motor fuel still absorbs much attention. Recent work has shown that mixtures of alcohol and petrol are much more stable if the alcohol is practically anhydrous. Such a mixture has been used successfully as a motor fuel in the munition works at Sevran-Livry. But even such a mixture would not solve the problem; the question of quantity is equally important. At least 220 mill. galls. of alcohol would be required to replace the 132 million

galls. of petrol consumed yearly in France; the annual output is only 22 mill. galls. Production from wood-cellulose, e.g., by the Prodor process (cf. J., 1922, 435 n) appears to be the most promising.

Prices in the chemical market are firm, owing to the appreciation of the pound sterling and the dollar. Following a rise in the prices of Italian and Spanish pyrites, and also in freights, there has been a marked increase in the cost of sulphuric acid.

"Synthetic" Mother-of-Pearl

In the October issue of *Chimie et Industrie*, MM. L. Clément and C. Rivière describe their researches into the formation of "synthetic" mother-of-pearl. Natural mother-of-pearl consists of a cellular skeleton of "conchyoline," an albuminoid material secreted by the oyster containing grains of calcium carbonate, and water. When calcium carbonate is precipitated in a colloidal medium, under certain conditions, it forms a network of particles which displays the optical phenomena of a grating. Similar but less pleasing effects can be obtained with salts of barium, lead, silver and copper, the superiority of calcium carbonate being apparently due to its fine grain. To reproduce this effect a solution is made of a calcium salt (preferably the lactate, glycolate or other salt of an organic acid) 15 parts, gelatin (to replace the conchyoline) 5 parts, and water 80 parts. This solution is heated, filtered, spread over the object to be treated, and allowed to set. A solution containing sodium carbonate 10 parts, trisodium phosphate 2 parts, gelatin, albumin, or casein 8 parts and water 80 parts, is then poured over the object to precipitate the calcium as carbonate. The characteristic iridescence appears after 30–60 minutes, and the object is then carefully washed, hardened with formaldehyde, and dried. The character of the nacreous appearance depends on the closeness with which the lines of cells containing calcium carbonate are packed, the most intense effects being obtained with 1000 to 1400 lines per mm. By varying the composition and rate of application of the precipitating solution, effects are obtained which vary from the weak lustre of oystershell to the iridescence of true mother-of-pearl. If a celluloid cast is taken of the surface of an object thus treated, the resulting film is also iridescent, thus showing that the effect is due to refraction from the fine reliefs reproducing the contours of the original. Films produced in this way may find application in decorative work. The mechanism of the precipitation of calcium carbonate in a colloidal medium is described as periodic or rhythmic precipitation (Liesegang, Ledue) and is of interest in the investigation of biological phenomena.

UNITED STATES

A News Edition of "Industrial and Engineering Chemistry"

Industrial and Engineering Chemistry, the technical journal of the American Chemical Society, announces an extension of its service in 1923. Besides the present journal, which will not be changed in form, there will be issued twice a month, on the tenth and twentieth, a chemical newspaper to be known as the "News Edition of Industrial and Engineering Chemistry."

The News Edition is designed to provide current information, much of it non-technical in character,

supplied to a large extent by staff correspondents. There will be a leading short article written in non-technical language on some phase of chemistry. Industrial developments, items on foreign and domestic commerce, digests of both Federal and State legislative action, tariff decisions, personal items, happenings in various local sections, announcements and preliminary programmes of the semi-annual meetings of the Society, and of local sections, will constitute the bulk of the material. A maximum of four pages will be devoted to employment service information under regulations soon to be announced.

With this publication available, the "Clip Sheet" of the News Service will be discontinued, and newspapers will be invited to use as much material as they please from the News Edition.

The News Edition will be issued under the joint auspices of *Industrial and Engineering Chemistry* and the A.C.S. News Service, in co-operation with corresponding editors in the various chemical centres and representatives of other chemical societies. The first issue will appear on January 10, 1923.

Production of Acids in 1921

Preliminary statistics issued by the U.S. Department of Commerce show that the output of factories manufacturing chiefly sulphuric, nitric, and mixed acids in the United States declined considerably in 1921. Of the 35 factories that reported, 5 were located in New Jersey, 5 in Pennsylvania, 4 in Ohio, 3 each in California and New York, 2 each in Maryland and Virginia, and 1 each in 11 other States. New Jersey was the leading producer, its output representing 27 per cent. by value of the total production. The statistics for 1921 and 1919 are summarised in the following table:—

	1921	1919	Decrease %
No. of factories	35 ..	39 ..	—
Persons employed	3,139 ..	5,800 ..	46.4
Salaried employees	450 ..	899 ..	49.9
Wage earners (average)	2,684 ..	4,901 ..	45.9
Salaries and wages	\$ 5,243,000 ..	10,096,000 ..	48.1
Salaries	\$ 1,317,000 ..	2,179,500 ..	39.6
Wages	\$ 3,926,000 ..	7,916,500 ..	50.4
Cost of materials	\$ 9,714,000 ..	15,857,000 ..	38.7
Value of products	\$20,529,000 ..	31,470,000 ..	34.8
Sulphuric acid (50° Be.) Short tons ..	1,457,500 ..	1,685,300 ..	13.5
.. ..	\$15,332,700 ..	18,113,000 ..	15.3
Nitric acid Short tons ..	2,110 ..	3,150 ..	33.0
.. ..	\$ 363,700 ..	536,700 ..	32.2
Mixed acid Short tons ..	16,400 ..	28,200 ..	41.8
.. ..	\$ 1,310,000 ..	2,671,500 ..	50.7
Other products	\$ 3,516,500 ..	10,149,300 ..	65.4

—(*Oil, Paint and Drug Rep.*, Nov. 13, 1922.)

An Indicator of Static Electricity

The accumulation of static electricity where inflammable dust or vapours are handled is a great but often unsuspected fire hazard, and the Westinghouse Lamp Co. has recently converted a laboratory curiosity into a very practical test for this hidden danger. The discharge of electricity through the gas in a Geissler tube is used to show the presence of high voltage near by; the gas used is neon, which readily conducts the discharge and causes the lamp to emit a bright reddish glow as a danger signal. The tube, mounted in an insulating case, has a metallic contact-tip at one end and a small condenser-plate at the other, and the whole apparatus is small enough to be carried about by an inspector; but it may be mounted where electricity accumulates and the charge run off to earth. The indicator is sensitive enough to glow

when the person holding it walks across a rug and connects its metallic tip to a radiator or other grounding device. A small neon-tube has also been marketed for use in testing sparking plugs on automobiles which may be running badly.

Fatigue of Metals

An investigation on the fatigue or progressive failure of metals has been carried out at the University of Illinois Experiment Station under the auspices of the Engineering Foundation and the National Research Council, with Prof. H. F. Moore in charge. The most probable explanation of such failure was found to lie in a progressive spread of microscopic fractures. A nucleus for damage may be a very small area of high localised stress, due to a groove, a scratch, or a crack. In other cases, failure may arise from internal inclusions or irregularities of structures, from internal stress remaining after heat treatment, or from a grain or group of grains being placed unfavourably to resist stress. Definite indications were found that tough steel possesses a specific endurance limit.

Cheap Furfural, a Substitute for Formaldehyde

As a result of more than six years' research work, the U.S. Bureau of Chemistry has devised a cheap method of producing furfural from corn (maize) cobs and farm waste. This method, it is expected, will eventually make possible the production of low-priced substitutes for a wide variety of hard rubber and synthetic-resin products, provide a good market for farm by-products now wasted, conserve the native supply of methanol and of forest products, particularly hardwoods, used in making methanol, and possibly provide a supply of motor fuel. When heated together furfural and phenol condense to form a solid resin, which is dissolved only with great difficulty; "tetralin" is said to be the only substance that will dissolve furfural resins. Three firms are now producing synthetic-resin products, using furfural instead of formaldehyde, and are obtaining satisfactory results. The furfural resins have a harder surface, and are naturally black or dark, rich brown in colour. They are somewhat flexible, and are better electrical insulators than hard rubber or other synthetic resin products. It has also been found that furfural is an excellent paint and varnish remover, and that it can be used in making fine dark varnishes. It is hoped, eventually, to obtain furfural from corn stalks, bagasse and rich hulls, as well as from corn cobs and oat hulls.

The process of manufacturing furfural, from corn cobs, etc., which was discovered by Dr. F. B. LaForge, of the Bureau of Chemistry, is rapidly being developed commercially. The present demand for furfural in the United States is said to be small. Two years ago it cost \$30 per lb., but now the one company producing furfural on a commercial scale is selling it at 25 cts. per lb. Dr. LaForge says that eventually, with production on a large scale, the price should be as low as 6 cts. More than twenty other firms are considering the building of furfural plants.

Furfural can also be used as a motor fuel, with a specially designed carburetter, and if greater yields were obtainable from farm waste, a subject now being investigated, its use as a fuel would be practicable.

BRITISH INDIA

Nux-Vomica Industry in Madras

Although *Strychnos nux-vomica*, the tree from which commercial nux vomica is obtained, is widely distributed throughout the tropics, the world's supply of the drug is almost entirely derived from India; and two-thirds of the Indian supply is furnished by the Madras Presidency. Despite the value of nux vomica as the source of strychnine and brucine, the tree is not cultivated, and in certain areas has almost disappeared owing to careless exploitation. The fruits are gathered by forest tribes, the pulp is washed away, and the seeds, after drying in the sun, pass through various hands until they reach the exporters, usually in December. For export the seeds are washed, sorted, and sold in bags of 164 lb. or 182 lb. each; they will keep for long periods, but storage is not usual. In 1920-21 exports amounted to 2268 long tons, distributed as follows: United Kingdom 1820.4 t.; Ceylon 13.2 t.; rest of British Empire 0.05 t.; Belgium 190 t.; France 0.6 t.; Italy 5 t.; United States 737.2 t. It is stated that the export in 1921-22 declined to 2010 t., but lately prices and shipments have increased. This year's crop on the west coast promises to be poor, but that on the east coast is above the average.—(*U.S. Com. Rep.*, Nov. 6, 1922.)

AUSTRALIA

Bounty on Shale-Oil Production

In 1917 the Federal Parliament passed an Act providing for the payment of a bounty on shale-oil produced in Australia. As this Act has expired, the House of Representatives has revived it for another year and increased the bounty from 2½d. to 3½d. per gallon, because the shale-oil company in New South Wales has been working at a loss. The increase in the bounty will involve an additional expenditure of £7000, the total cost for the year being about £74,000.—(*Ind. Austr.*, Oct. 19, 1922.)

GERMANY

Chemically-resistant Iron

Articles made of a 15 per cent. aluminium-iron alloy develop, on being heated to redness, a thin but highly resistant surface layer of aluminium oxide which does not scale and prevents further oxidation of the metal, so that no appreciable alteration of the surface is noticeable after heating at a high temperature for one hour in a strongly oxidising atmosphere. The alloy gives good castings and may, with care, be forged. Similar results are obtained by treating soft-iron articles by the Alitier process, which consists in heating the metal for some time surrounded by a powder containing aluminium, whereby the latter penetrates the surface of the iron for a certain distance and forms a surface layer of iron-aluminium alloy that behaves in a similar manner to the 15 per cent. alloy described above. An iron crucible treated by this method was practically unattacked after heating to 1000° C. for 60 hours, whereas a similar untreated crucible was destroyed in 24 hours.

Filter for Industrial Dust

The Cottrell dust-precipitator has the disadvantage that the finest dust tends to form hard crusts on the precipitating walls, and in the case of

metallic fumes, the crust has to be chiselled away owing to the metal in the fume welding itself to the walls. Cloth filters are rapidly clogged by the dust and cannot be used with hot gases. On the other hand filters consisting of metal vessels packed with small ring-shaped pieces of metal or wire nets of fine mesh have none of these drawbacks and work very efficiently. For temperatures below 80° C. the filters are treated with a special oil, having a viscosity of 3.8 at 50° C., a solidifying point of -20° C., a flash-point of 155° C., and an evaporation loss of 0.02 per cent. in 5 hours, in such a manner that the surface of each wire is coated with a thin layer of oil. For higher temperatures oil is not used. In the collecting chamber for coarse dust, which is provided in front of the filter, 60 per cent. of the total dust is precipitated, and another 35 per cent. is collected on the filter. In each case the dust is readily removed either by mechanical shaking or by pneumatic means.

The Potash Industry, Jan.-June, 1922

According to official statistics the German output of potash during the first half of 1922 was 5,893,711 metric tons of potash salts, equivalent to 682,787 t. of pure potash (K_2O). Details of the production and inland sales of potash salts (calculated as K_2O) are given as follows:—

	Production Jan.-June, 1922 1000 t. K_2O	Inland sales 1922 1000 t. K_2O
Carnallite	22,739	1.31
Crude salts	138,710	137.92
Manure salts (18-22%)	39.20	18.61
" " (28-32%)	19.35	16.02
" " (38-42%)	241.34	245.47
Potassium chloride (50-60%)	90.78	102.91
" " (over 60%)	37.80	
Potassium sulphate (over 42%)	17.11	3.98
Potassium-magnesium sulphate, calcined	6.25	0.46

Inland sales during the first six months of 1922 increased by 58 per cent. compared with the same period of 1921, largely owing to improved transport facilities and rebates granted on orders. Roughly 490,000 t. of potash, equivalent to 93 per cent. of the total inland sales, was consumed by agriculture, and 7 per cent. was sold for industrial purposes. Sales on foreign account were below expectation.

Following the increased consumption inland, the potash works have been fully occupied. From January to June, 1922, the number of workers rose from 39,594 to 42,139, or inclusive of subsidiary workers, from 44,244 to 47,577. However, pre-war conditions have by no means been re-established. Of the 206 works which were authorised to make deliveries, 76 were idle at the end of June.

The Welfare of Chemical Workers

The following observations on the influences affecting the health of workers in chemical factories were made in 1921, and have been published recently.

The advisability of having long pauses for meals and rest has been established; when these are cut down to a minimum, production by manual workers falls off, and brain-workers suffer from nervous exhaustion, sleeplessness, and gastric complaints. Among industrial poisons, lead still takes first place, although this danger has been much exaggerated, lead-poisoning being frequently suspected where the symptoms really arise from other causes; it now appears, too, that the only really reliable indication of lead poisoning is obtained from the blood-test. In many places changes in the

methods of winning and working the metal have reduced the danger. Chromium also acts prejudicially to health. Other causes of poisoning have been phosphine (from moist ferro-silicon), sulphur dioxide, hydrogen sulphide, cyanogen, chlorine, nitrous gases, blast-furnace gases, illuminating gas, nitro- and amido-compounds, picric acid, trichloro-ethylene, and tetrahydronaphthalene. Numerous cases of poisoning by dinitrobenzene were observed in the breaking up of ammunition. Various skin diseases were caused by chemicals and impure oils.

Hygienic conditions in the factories have generally improved, especially in the large works. The installation of improved ventilating and dust-removing apparatus has been very difficult owing to the exceptionally high cost; and the provision of cloak-rooms and rooms for rest and refreshments still leaves much to be desired. Washing conveniences, especially bathrooms, are often badly treated by the workers, and in many cases not used at all. Among special installations for the benefit of workers may be mentioned a mechanical remover of ashes and slack from boilers. The neglect and ill-treatment by workers of protective devices introduced for their benefit was regrettable. Members of industrial councils and foremen seem to have a far greater appreciation of measures developed to protect health than measures to prevent accidents, and in respect of the former, there is frequently successful co-operation with the workers; in many districts lectures and special courses are held for their instruction.

GENERAL

Pasteur Celebrations

Prior to the celebration of Pasteur's centenary in May, 1923 (*c.f.* J., 1922, 111 n), meetings in his honour will be held in this country from February 2 to 19, 1923, under the auspices of the Federated Committees of the Alliance Française in the United Kingdom. The hon. secretary of the Federated Committees, Mlle. Yvonne Salmo, of 14, Morgan Road, Reading, informs us that Dr. Pasteur Valléry-Radot, the grandson of Pasteur, will deliver a lecture on his grandfather's life and work in the rooms of the Royal Society of Medicine, London, and this will be followed by a banquet which will be attended by members of that Society and of the Institute of Brewing, and to which it is proposed to invite members of the various chemical societies. M. René Valléry-Radot will come to London, but his health will not permit him to go to the provinces, where Dr. P. Valléry-Radot will visit Manchester, Newcastle, Bradford, Liverpool, Cardiff, Reading, Leicester, Wolverhampton, Southampton, and Portsmouth (Feb. 19). In each of these towns the local branch of the Alliance Française is inviting the medical and chemical societies to take part in the proceedings. The Lord Mayor of Cardiff will extend a civic welcome to the visitors, and at Newcastle-on-Tyne Sir Theodore Morison will offer the hospitality of Armstrong College.

Glasses for Flame Safety-Lamps

The report of the sub-committee appointed to compare flame safety-lamp outer glasses made in Great Britain, Germany, Austria, and Czechoslovakia from the standpoints of safety, transparency, and price has recently been issued by the

Mines Department (H.M. Stationery Office. 2d.). Tests carried out at the Mines Department Experimental Station have shown that there is no difference in quality between British- and foreign-made glasses; the former are more transparent, free from flaws, and uniform in surface, but the latter are usually more uniform in dimensions. All the British glasses and most of the foreign glasses passed the heating and mechanical tests satisfactorily. In the absence of reliable data, no conclusion was reached concerning the price of foreign glasses, but information was received that, apart from import duty levied in this country, Czech glassware is now more expensive than British glassware, and that the cost of production in Germany and Austria is less than in this country. It is recommended that the difference between the prices of British glasses to lamp makers and to colliery companies, viz., 8s. 6d. and 10s. 9d. per dozen, respectively, be investigated. No approved glasses have been imported from the United States for some time and no glasses of French or Belgian manufacture have been submitted for approval for use in this country.

New Oil-nuts from South America

Nuts from a palm growing abundantly in the Magdalena Valley, Colombia, and known locally as "Mamarrón," have been examined at the Imperial Institute, and found to belong to a species of *Attalea*, allied to the corozo and cohune nuts. Analysis showed the kernels to contain 3.8 per cent. of moisture, and 69.9 per cent. of fat, or 72.7 per cent. calculated on dry material. The percentage of shell (79.3 per cent.) is too high to allow the export of whole nuts, but commercial quantities of the kernels should realise about the same price as palm kernels (£17 10s. per ton in June, 1922). The kernel oil, which is cream-coloured, hard, and has an odour like that of coconut oil, should be suitable for use in manufacturing edible fats, and as the residual meal is free from alkaloids or cyanogenetic glucosides, it might be used as a cattle-food.

"Fruta de conejo" (rabbits' fruit) nuts belonging to a species of *Heisteria*, were also sent from the same district for examination. The kernels, which constitute 66 per cent. of the nut, contained 5.4 per cent. of moisture and 61.2 per cent. of a clear, golden-brown viscous oil, equal to a yield of 64.7 per cent., from the dry material. Although the oil has a high iodine value (140 per cent.), it does not possess good drying properties, and is unsuitable for paint manufacture. On heating it polymerises, yielding a product like polymerised tung oil, and therefore might be used in making rubber substitutes, etc. The residual meal is of high nutritive value, but as a trace of alkaloid is present, feeding trials would be necessary before using the meal for feeding cattle.—(*Bull. Imp. Inst.*, XX, No. 2, 1922.)

Power Alcohol in Cuba

H.M. *Chargé d'Affaires* at Havana reports that increasing attention is being paid to the production of fuel alcohol in Cuba. As the alcohol distillery can easily be made part of the sugar factory, a great part of the lower grade material may in future be converted into alcohol instead of sugar. At present only two mills distil alcohol from the final

molasses or waste material. Under proper conditions a gallon of alcohol can be produced from 2 galls. of molasses containing 56 per cent. of fermentable sugars, but with the inefficient methods generally used 3 galls. of molasses yield only 1 gall. of 95 per cent. alcohol. In 1919-20, when the sugar crop reached 3·75 million t., the output of molasses was over 185 mill. galls., an amount which could yield from 60 to 90 mill. galls. of alcohol. It is estimated that, with a plant capable of producing 7200 galls. of fuel alcohol per 24 hrs., i.e., able to utilise the daily output of molasses from a 3000-ton raw sugar plant, the alcohol could be produced at 12·55 cents and sold at 20 cents per gall. Production of alcohol is most important in the province of Matanzas, where there are 3 distilleries with storage capacities for 2,880,000, 2,660,000 and 1,200,000 galls., respectively, and two distilleries each capable of storing 175,000 galls. Local consumption, formerly less than the production, has now risen owing to the increasing use of fuel alcohol for automobiles, and there is a large export trade, chiefly with the United Kingdom, South America, Morocco and, latterly, Germany. Efforts are being made to increase the consumption of power alcohol.—(*Bd. of Trade J.*, Nov. 16, 1922.)

Artificial Silk in Italy

The Italian artificial-silk industry, founded about 15 years ago, has an invested capital of 420 million lire, and comprises five large factories at Pavia, Padua, Venaria Reale, and Cesano Maderno, which produce nearly 11 metric tons of silk per day; it employs 12,000 workers now, and will probably employ 20,000 a year hence. Some of the necessary raw materials, i.e., soda, carbon bisulphide, and sulphuric acid, are produced locally and it is hoped that in time wood pulp will be obtainable in the country. At present, the production is below the home demand, and there is both an import and export trade.

	Imports	Metric tons	Exports
1919	78·6	230·4
1920	374·1	396·4
1921	254·9	906·1

Belgium, Switzerland, and the United States are the chief sources of the imported artificial silk, and the United States, France, and Switzerland the destinations of the exports. Exportation has naturally been directed to countries possessing a relatively high rate of monetary exchange (*cf. J.*, 1922, 314 n).—(*U.S. Com. Rep.*, Sept. 25, 1922.)

Kaolin Deposits in Dobruja, Rumania

Kaolin was known to occur in the hill-country between Balceic and Cavarna prior to the war, but recently large deposits of this mineral have been discovered. The Rumanian Government has decided to erect a large porcelain factory at Balceic, and to use skilled labour, mainly from Czechoslovakia and Austria.

Method of Renovating Old Corks

Old cork stoppers can be cleaned and softened by boiling them, suitably weighted, in a 5 per cent. solution of sulphuric acid for 15 minutes. After rinsing several times in water, the corks are boiled in clean water for 15 minutes, and when cold they are placed in a 5 per cent. solution of alum for 6 hours, and then dried in the sun for 2 or 3 days.—(*Chem.-Z.*, Sept. 28, 1922.)

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Imports and Output of Beet Sugar

Answering Major T. Hay, Sir P. Lloyd-Greame said that importations of unrefined beet sugar into the United Kingdom in 1921 amounted to 13,685 tons, compared with a home production of 6363 t. The trade returns did not distinguish between refined sugar manufactured from beet or from cane.—(Dec. 11.)

British Dyestuffs Corporation

Sir P. Lloyd-Greame, in reply to Major M. Wood, stated that during the three months ended November 30, commission paid to the Corporation amounted to £4600, and the proceeds of sales of "reparation" dyestuffs was approximately £66,000. The sterling value of the dyestuffs received during that period was, according to the Reparation Commission, about £107,000.—(Dec. 11.)

Trade Information Register

In answer to Sir H. Brittain, Sir W. Joynson-Hicks said that 2766 firms were enrolled on the special register of the Department of Overseas Trade for the purpose of receiving information from abroad. The Department was in touch with many more firms, but prompt distribution of commercial information would be facilitated if firms desiring such information would enrol on the special register.—(Dec. 11.)

Scotch Shale-Oil Industry

Replying to Mr. Shinwell, Mr. Baldwin stated that sale of the Government holding in the Anglo-Persian Oil Co. was not contemplated, but if it ever were, the Scotch shale-oil industry and other relevant considerations would be taken into account.—(Dec. 11.)

Australian Zinc Concentrates

Viscount Wolmer informed Mr. Collison that, owing to the improvement in the market price of spelter, probably no loss would result from the operation of the contract for the supply of Australian zinc concentrates.—(Dec. 12.)

Imports of Petroleum

In a written answer to Lieut.-Col. James, Mr. Ormsby-Gore gave the following statistics of the imports of petroleum from Empire territories enjoying Imperial Preference and of the output of those countries:—

	Output 1921	Imports into U.K. 1921	Output Jan.- June 1922	Imports into U.K. Jan.-June, 1922
			Tons.	
Canada	25,000	nll	12,000	nll
Australia	8,000	nll	4,000	nll
Trinidad	334,000	108,205	161,000	60,076
British India ..	1,285,000	11,170	575,000	7,318
Sarawak	199,000	13,955	178,000	nll

—(Dec. 13.)

Insulin Treatment for Diabetes

Answering Sir W. Bull, Sir W. Barlow said that the Medical Research Council was doing all it could to accelerate the production and use of insulin for treating diabetes. It was not true that the remedy had passed the experimental stage, there was no question of any Government monopoly, and the

suggestion that the Medical Research Council should grant licences for manufacture was on the lines of the practice actually followed.—(Dec. 13.)

Safeguarding of Industries Act

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Duties.—Up to and including December 8 the duties collected in Great Britain and Ireland under Parts I and II amount to £445,324. Since the Act was passed the expenditure of the Customs has decreased.—(Dec. 11.)

Domestic Glassware.—Imports of domestic and fancy glassware during the first half of 1922 included 2052 tons from Germany and 4334 t. from Belgium.—(Dec. 11.)

COMPANY NEWS

MAGADI SODA CO., LTD.

Addressing the eleventh ordinary general meeting of this company on December 11, in London, Mr. S. Samuel, the chairman, said that the very unsatisfactory position of the company had been brought about by causes beyond the control of the directors. Production had been hindered throughout by the failing of machinery, and the fixing of the rate of exchange at 2s. to the rupee had seriously interfered with all industries in East Africa. The directors were still confident of ultimate success, and he personally had guaranteed the advances made by the bank to the company; in 1921 no less than £72,500 was advanced. The defects in the new bucket-dredger which had been sent to Magadi had now been made good, and the dredger had been re-started; in a few weeks there would be a minimum production of soda at the rate of 100,000 tons a year. It would be necessary to write down drastically the existing capital and to raise further capital; if the shareholders would find a further £500,000, he would contribute £50,000; if a million of new money were found, he would put up £100,000.

MAYPOLE DAIRY CO., LTD.

Sir W. G. Watson, presiding at the annual general meeting in London on December 15, discussed the difficulties confronting the company owing to the fiscal policy of foreign countries. During 1921, over 1000 tons of margarine had been imported each week, the result being unemployment and unprofitable prices in this country. Abroad, imports of oil and margarine were dutiable, but the raw materials used in manufacturing edible fats were duty-free; in consequence the factories could work at full capacity, thereby reducing working costs. This state of affairs gave an advantage of at least 1s. per cwt. to the foreign manufacturer competing in the free British market. The large Continental companies controlling both Continental and British factories had already adopted the policy of transferring manufacturing operations from England to the Continent, but the Maypole Company would do this only under pressure of necessity, as it would lead to increased unemployment, reduce supplies of British-made cattle cakes, and render the country dependent in war-time on foreign supplies of essential food. The amounts paid in dividends were not quite covered by the year's

profits, as it was expected that the Company's claims against the Government would have been settled before the accounts were presented.

THE PEACHEY PROCESS CO., LTD.

At the second annual meeting held recently in London, Sir J. P. Hewett, chairman of the company, said that the expectation of improved industrial conditions during the past year had not been realised, and the uncertain political and economic situation both at home and abroad had delayed the manufacture of a number of raw products by the Peachey process. Licences had been issued in this country for the vulcanisation of crude rubber articles, such as boot soles and mats, and for surfacing leather with rubber. The production of moulded goods by the two-solution method had been perfected, and manufacture should begin in the spring. Licences had also been granted for manufacture in Belgium, Ceylon and Malaya, and as soon as the appeal against the decision of the United States Patent Office in favour of the company's application had been heard, manufacture would begin in the United States. The prime aim of the company was to secure the manufacture of its products on a commercial scale in the United Kingdom, and success in this direction would materially assist negotiations abroad. There was reason to be confident that in the coming year Peachey products would be manufactured on a large scale by substantial undertakings in this country. The sum paid up for preference and ordinary shares amounted to £79,006.

REPORTS

REPORT ON THE ECONOMIC CONDITIONS IN SOUTH AFRICA, DATED JULY, 1922. By W. G. WICKHAM, H.M. Senior Trade Commissioner in South Africa. Department of Overseas Trade. Pp. 49. H.M. Stationery Office, 1922. Price 1s. 6d.

Several new industrial enterprises have been initiated during the past two years, among which may be mentioned a rubber factory at Howick Falls (Natal), a blast furnace at Newcastle, the manufacture of sheep-dips and fertilisers in the explosives factory at Somerset West, a paper factory, and an additional cement works. Experiments on the distillation of coal have been continued, and the production of power alcohol is being investigated. Difficulties still confront the winning of natural soda, and a steady output has not yet been attained. The mining industry has suffered from high costs of production and the low prices of metals, the diamond and gold mines being particularly affected. There was a short boom in the coal-mining industry, due to the coal stoppage in the United Kingdom; and it is hoped that with the provision of improved facilities for handling coal at the ports and on rail, the output will steadily increase. The Government has decided to encourage the production of iron and steel and copper by paying bounties on production. (For the mineral production of 1921, cf. J., 1922, 199 R). The Government is assisting agriculture with legislation designed to ensure that only produce of uniform grade and best quality shall be exported; and methods of preventing drought are being investigated by a commission.

Excluding imports for the Government valued at £7,922,024, the value of the imports in 1921 was £49,878,292 (£93,404,962 in 1920); among the chief items were: Iron and steel £1,266,384; leather, unmanufactured, £115,561; wax, paraffin, stearin, £249,931; glass, glassware £428,667; oils £2,777,465; paints, etc., £333,384; drugs, chemicals, medicines, £1,063,648; rubber goods £338,605; paper, all kinds, £1,119,318. The imports originated as follows, per cent.: United Kingdom 51·8; rest of British Empire 11·4; United States 16; Germany 2·3; Sweden 2; Japan 1·4. Competition from Japan and the United States has decreased, but German competition was severe in aluminium ware, enamelware, glassware, earthenware, china, and cement. The United Kingdom gained a larger proportion of the trade in glass and glassware, but lost ground as a source of fertilisers, basic slag being supplied by Holland and Belgium and superphosphate by Holland. Exports were valued at £57,960,154 (£77,799,172 in 1920), and included: Bark, wattle and extract, £570,127; hides and skins £1,226,876; sugar £2,065,359; coal (except bunker coal) £1,949,014; diamonds £1,355,487; gold, crude, £34,453,586; oil, whale, £25,191; soap £19,957; fertilisers £31,317. Of the total exports the United Kingdom took 79·8, Germany 4·1, and the United States 2·6 per cent.

RAPPORT SUR LE COMMERCE ET L'INDUSTRIE DE LA SUISSE EN 1921. Pp. 438. Zürich: *Union Suisse du Commerce et de l'Industrie*, 1922. Price 9 francs (Swiss).

In the section of this report that is devoted to chemical industry it is stated that during 1921 there was little demand for hydrochloric and nitric acids, and that after a long stoppage the soda factory at Zurzach was sold to the Solvay company. Sales of nitric acid made by the arc process were also limited, but improved towards winter, when the demand for sulphuric acid also improved. The new sulphuric-acid factory at Martigny began to produce in the autumn, but that at Schweizerhall has not yet made any sales. Heavy losses were made by the fertiliser industry, owing to the small demand and foreign, especially Belgian, competition. At the close of the year prospects for the Swiss heavy-chemical industry were unfavourable, and it was felt that relief could only come when home prices approximated to foreign prices.

The electrochemical and electrometallurgical industries depreciated further during the year and several factories began to utilise their power for other purposes. Most of the carbide factories remained closed, and though the export was the same as in 1920, viz., 9890 metric tons, the average value fell from 44·9 fr. to 35·93 fr. per quintal. About 2000 t. of acetaldehyde, metaldehyde, acetic acid, etc. was prepared from carbide, and cyanamide was made only in one factory, that of the Société des Produits Azotés at Martigny, which also manufactures sulphuric acid for use in making ammonium sulphate and a new fertiliser, "phosphazote" (cf. J., 1922, 390 R). The output of ferrosilicon was at most 3000 t., and that of ferro-alloys fell to 200 t., exports of abrasives practically ceasing. Manufacture of "synthetic" iron was continued with difficulty, owing to German competition, and the factory at Bex is now making cement as well as

electric iron; many factories, however, consume their own production of electric iron. No progress was made by the aluminium industry and supplies of raw materials did not permit production at full capacity, but exports increased by 2490 t. to 8610 t. Nitrate of lime had difficulty in meeting competition from Chilean nitrate.

Electrolytic products suffered from the small demand and low prices, but there was a steady sale of electrolytic soda lye; the demand for potassium chlorate improved towards the close of the year; the consumption of bleaching powder decreased by one-half. Production of hydrogen peroxide increased slightly, but high prices limited the demand for percarbonates, perborates, and persulphates. Production of copper sulphate and salts of various metals proceeded normally at Bex throughout the year.

Unfavourable conditions prevailed in the manufacture of dyestuffs, photographic chemicals and synthetic perfumes, the colour, lake and varnish industry being severely affected by the economic crisis. The explosives industry, already suffering, was still further depressed by the abolition of import prohibitions on explosives; no advances were made by the industry and the trials of liquid air as an explosive gave unsatisfactory results. The position of the manufacturers of pharmaceutical products would have been most serious had not the Germans begun to quote prices in foreign currency in October, and had not the quality of their products been unsatisfactory. Slightly better conditions prevailed in the soap industry, although soap for industrial purposes was in small demand. Many of the match factories reduced their output until relief was obtained by restrictions on the heavy imports from Czechoslovakia in December. Stagnation prevailed in the ceramic and glass industries generally and despite reductions in the cost of fuel, prices were still above the foreign level.

THE BACTERIOLOGY OF CANNED MEAT AND FISH. By W. G. SAVAGE, R. F. HANWICKE and R. B. CALDER. *Food Investigation Board, Special Report No. 11*. Pp. 72. Department of Scientific and Industrial Research. H.M. Stationery Office, 1922. Price 2s. 6d.

The objects of the investigations, described in the report, were as follows:—(a) To study how far canned foods contain living bacteria or poisonous products thereof. (b) To ascertain to what extent canned foods passed for consumption are sterile and if not sterile, the significance of the organisms found in them. (c) To study the bacteria associated with the spoilage of canned foods with a view to diminishing waste from such causes. The report deals only with canned meat and fish.

Methods of Examination.—Every precaution was taken to avoid outside contamination, and in doubtful cases the organism isolated was rejected. Reliance was mainly placed on liquid media. Egg-meat-broth, nutrient broth, and nutrient Agar were the primary media most employed, and a general reaction of $p_H=7·2$ was found suitable.

For anaerobic cultivations palladium-hydrogen jars* were used, but as the complete removal of oxygen by this method is doubtful, or uncertain,

* Med. Research Committee, Special Report, No. 12

additional precautions were taken in certain cases. The incubation period sometimes extended to three or four months, and the temperatures adopted were 21°, 37°, and 55° C.

The characters of the organisms isolated were all studied in pure cultures, and special stress was laid on the following:—

(1) Spore formation; (2) oxygen requirements; (3) optimum temperature for growth; (4) ability to decompose proteins, as indicated by liquefaction of blood serum; and (5) ability to decompose carbohydrates with gas production. In all, 116 tins of meat and 207 of marine products were fully examined, the larger number being tins which had been rejected at the port of entry and the remainder sound tins purchased from shops. A few other tins were used for inoculation experiments and in other ways. The organisms isolated come under the following groups:—

(1) *Moulds*. These were only found in 8 samples, and there was no evidence that they could cause either "blowing" or extensive decomposition, though their presence rendered the meat unsalable. Their presence indicates access of air.

(2) *Obligate anaerobes*. Found in 27 tins. Most of the strains isolated were proved to be capable of producing "blowing" as well as extensive putrefaction.

(3) *Sporing anaerobes*. Owing to their wide prevalence in both sound and unsound samples, to their power of resisting heat and to their proteolytic activity, this group is of great importance.

Of the five sub-groups of organisms isolated the majority liquefied blood serum, and were therefore potential causes of decomposition. Absence of sufficient air would prevent their growth in sound tins. Long incubation of tins inoculated with the non-proteolytic strains left the contents quite unaltered. Some strains were found to grow well under the severest anaerobic conditions which could be obtained, without, however, any decomposition being observed, possibly because the proteolytic enzymes are produced under strict anaerobic conditions.

No strains of pathogenic type were found.

(4) *Thermophilic Bacteria*. These were widely distributed in both sound and unsound tins. Some could only grow above 37° C. Few of them liquefied blood serum, and none produced gas from carbohydrates. They were non-pathogenic, and their presence has little significance.

(5) *Non-sporing arobes*. Of these 78 varieties were isolated. Some of the proteolytic strains could also produce gas from carbohydrates. Some of *B. Proteus* type were markedly pathogenic.

(6) *Micrococci*. These occurred in 23 per cent. of the tins of which the majority were sound. None was gas-producing, and only three were proteolytic. They are not a cause of spoilage, and were not found to be pathogenic.

The results as a whole inculcate that the aim of manufacturers should be to obtain their raw material as fresh as possible, can it as quickly as possible at the right temperature and under the cleanest conditions, and by the use of good quality tinplate and efficient closing methods, to ensure the presence and the maintenance of a vacuum in the tins.

The report closes with a review of previous work on the subject and an excellent bibliography.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for December 7 and 14)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W.1), from firms, agents or individuals who desire to represent U.K. Manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Austria ..	Manganese ore with 70-92 per cent. manganese and little iron ..	628
Canada ..	Metals	625
" ..	Celluloid articles	645
" ..	Rubber manufactures	646
Cuba ..	Leather	6131/F.L./M.C.
Egypt ..	Soap (tender for)	9482/F.E./T.C.
" ..	Soap, perfumery	638
Norway ..	Pig iron, galvanised iron, tinplate ..	632
Portugal ..	Lard, margarine	654
Switzerland ..	Iron and steel	637
Trinidad ..	Tinplate, solder	627
United States ..	Oils, pigments for making artists' colours	639
" ..	" Stainless " steel and iron ..	658
Uruguay, Argentina ..	Glassware	661

TARIFF CUSTOMS EXCISE

Australia.—Definitions have been issued in connexion with the application of "dumping" duties. A special anti-dumping" duty has been applied to gold paint from Germany. The method of assessing *ad valorem* duties has been revised.

Costa Rica.—An additional tax of 0.25 centimo (gold) per kg. is leviable on all imported goods that are dutiable.

China.—The revised schedule of duties leviable under the revised import tariff is set out in the issue for December 14. Many chemicals, dyes, pigments, fats, waxes, oils, etc. are affected.

Egypt.—A list of revised tariff valuations for non-ferrous metals is given in the issue for December 7.

France and Algeria.—Recent modifications of the customs tariff affect animal wax, olive oil, vaseline, aluminium, copper and bronze foil, ammonium compounds, iodine and its compounds, tanning extracts, chloral hydrate, monochloroacetic acid, glycerin, tartaric acid, colours, soap.

France and Italy.—A complete translation of the commercial arrangement between France and Italy is published in the issue for December 7.

Grenada.—Rules have been issued controlling the importation of matches.

Mozambique.—The export duties on oilseeds have been modified. Building materials and material for sugar factories may be imported duty-free.

Poland.—The export duty on crude petroleum has been raised from 15 to 50 Polish marks per kg.

San Salvador.—Insecticides may now be imported free of duty.

Sudan.—The importation of alcoholic liquors is prohibited, save under licence.

United States.—All imported goods must be marked with English words indicating the country

of origin. Certain goods not so marked may be marked after arrival under customs supervision and delivered after payment of an additional duty of 10 per cent. *ad valorem*.

TRADE NOTES

BRITISH

New Zealand in 1921

According to the report issued by the Department of Overseas Trade on commercial conditions in New Zealand (H.M. Stationery Office. Price 1s. 9d.), imports were valued at £42,942,443 and exports at £44,828,827 during 1921, compared with £61,595,828 and £46,441,946 in the previous year. The apparently favourable balance of trade in 1921 is misleading, as the customs valuations of imports are below the trade value and the amount of interest payable on foreign loans is not included. During the early part of the year, deliveries under old orders were heavy, but very few new orders were placed, and not till later in the year did buying improve. Some of the chief imports and countries of origin are given below:—

	£	Origin, per cent
Oils, fats, waxes ..	2,948,636 ..	U.S. 81, U.K. 5.5
Paint, varnish ..	393,643 ..	U.K. 80, Australia 24, U.S. 12
Metals, crude or partly manufactured, and ores ..	538,288 ..	U.K. 52, Austr. 37
Rubber and manufactures of (excluding tyres) ..	87,807 ..	Austr. 64, U.K. 24, U.S. 9
Leather and manufactures of ..	440,168 ..	U.K. 52, Austr. 31, U.S. 14
Ceramic wares, cement ..	1,113,719 ..	U.K. 56, Austr. 13, U.S. 10
Paper ..	1,286,932 ..	Canada 42, U.K. 36, U.S. 9
Drugs, chemicals, etc. ..	1,082,436 ..	U.K. 47, U.S. 22, Austr. 20
Fertilisers ..	367,074 ..	Austr. 24, U.S. 8, Japan 6, U.K. 2

Per head of population, New Zealand is now the largest importing country in the world, and also the largest importer of British goods. Imports of dyes in 1921 were valued at £98,257, of which the United Kingdom supplied £47,835 and the United States £17,690; imports of German dyes rose from £23 to £14,820, but these were largely "reparation" dyes sent from Great Britain. The United Kingdom maintained its position as the chief source of medicinal preparations, drugs, perfumery, etc., but lost ground in the trade in basic slag and superphosphates, which were derived mainly from Belgium. The exports included 452,231 bales of wool, large quantities of dairy produce and meat, 329,113 hides and 8,336,702 sheep skins.

Kenya in 1920-21

The official report on the Colony and Protectorate of Kenya during 1920-21 states that although agricultural development proceeded actively during the early part of the year, the subsequent fall in prices caused a decline in production. The fertility, favourable climate, and cheap labour supply of the Colony suggest that it will eventually become an exporter of coffee, maize, sisal, flax, and certain oilseeds. The natives cultivate 24,280,000 acres of very fertile soil, whereas the Europeans cultivate only 3,157,000 acres; in addition there is 9 million acres under pasture. Sisal was grown on 30,698 acres in June, 1920; there were 21 sisal factories, with a daily capacity of 52.5 tons of fibre, and the industry seems fairly profitable. Native coconut plantations cover a large area, and the output of copra should increase considerably when the plan-

tations on European estates come into bearing. An area of 6000 acres near Kibos has been alienated for the cultivation of sugar-cane, and a factory is to be erected to supply the requirements of the Colony and adjacent territories in sugar. An attempt to prepare limejuice has failed, but efforts are now being made to manufacture concentrated citric acid for export. Apart from a small quantity of graphite no minerals have been produced except for assay, but 974 prospecting licences were issued and 322 claims were registered, of which 166 were for gold and 93 for precious stones.

Imports increased in value by 48 per cent. to the record figure of £6,911,858, of which £3,516,075 represented goods from the United Kingdom. The value of the combined exports from Kenya and Uganda rose by 4 per cent. to £4,699,498; they included: cotton 1926 tons (Kenya 81 t.); coffee 7913 t.; grain and oilseeds 22,446 t.; fibre 5702 t.; carbonate of soda 12,829 t.; copra 468 t. The percentage distribution of the sodium carbonate was as follows: United Kingdom 7, India 26, Norway and Sweden 37, and Japan 19.—(*Col. Rep.—Ann., No. 1122, 1922.*)

Zanzibar in 1921

Although no cloves have been planted in Zanzibar for 20 years and many trees have died, the production has not diminished, and in 1920-21 the crop increased to 8555 tons. Government nurseries of clove trees and coconut palms have been established to assist planters. Exports of copra amounted to 6942 t., but the quality will not improve until drying-plant can be obtained. The export of chillies was 48,432 lb. The total imports increased by 21.5 per cent. to 72,611 t., valued at Rs. 3,22,32,946, gains being shown by cotton textiles, motor-spirit, petroleum, etc. Exports amounted to 45,036 t. (Rs. 3,24,64,049), the increase of 15.9 per cent. compared with 1920 being due to the heavy clove crop and to re-exports of motor-spirit and petroleum. The foreign trade of the Colony was distributed as follows (per cent.):—India and Burma 26, Tanganyika Territory 19, United Kingdom 16, Kenya 8, France 6, the order of importance being the same as in 1920.—(*Col. Rep.—Ann., No. 1125, 1922.*)

FOREIGN

Fertiliser Prices in Germany in October, 1922.

During the period July to September, prices of fertilisers in Germany increased by 210 per cent. Figures showing the prices at the works in marks per 100 kg. in 1913 and in July and October, 1922, are given below:—

	Average prices of fertilisers in Germany			Inc. over price in 1913
	1913	July, 1922	Oct. 11, 1922	
				Per cent
Carnallite	0.765 ..	32 ..	114 ..	148.8
Kalinite	1.20 ..	51 ..	182 ..	151.9
Manure salts (20%) ..	2.80 ..	110 ..	412 ..	147.1
" " (30%) ..	4.35 ..	120 ..	767 ..	176.2
" " (40%) ..	6.20 ..	317 ..	1,310 ..	210.2
Potassium chloride (50%) ..	13.50 ..	442 ..	1,787 ..	132.4
Potassium sulphate ..	16.80 ..	573 ..	2,855 ..	169.9
Potassium magnesium sulphate ..	8.06 ..	341 ..	1,699 ..	210.8
Basic slag	3.75 ..	278 ..	1,200 ..	320
Superphosphate ..	5.95 ..	572 ..	2,295 ..	385.7
Cyanamide	21.28 ..	1,135 ..	4,904 ..	230.5
Ammonium sulphate—				
Ord.	27.78 ..	1,415 ..	6,131 ..	220.7
Dry	28.08 ..	1,464 ..	6,344 ..	225.9
Sodium nitrate ..	22.40 ..	1,324 ..	5,749 ..	256.6

Italian Trade in Sulphur

Exports of sulphur from Italy are now confined almost entirely to Europe and countries on the eastern Mediterranean, as many markets have been lost entirely or in part to American producers owing to the high cost of production in Sicily, which is due to antiquated methods of extraction and the high cost of labour. The export of sulphur during the nine months ended March, 1922, was 54,402 metric tons, valued at 44,666,740 lire, and during the first quarter of 1922, 36,434 t., worth 29,493,350 lire, of which 16,280 t. was taken by Greece, 4344 t. by France, and 2860 t. by Germany.—(*U.S. Com. Rep.*, Nov. 27, 1922.)

REVIEWS

THE CHEMISTRY AND TECHNOLOGY OF GELATIN AND GLUE. By DR. R. H. BOGUE. *Mellon Institute Technical Series*. Pp. xi.+641. London: McGraw-Hill Book Co., Ltd., 1922. Price 30s. net.

The aim of the author has been to supply a want, long felt by students and investigators, of an up-to-date account of the principles of the manufacture, testing and general applications of gelatin and glue. No book has appeared before which has treated these matters purely from a scientific point of view. The subject is a very complex one, like all others depending upon colloidal chemistry, and the fact that the method of treatment is new increases the difficulty of producing a standard work. Nevertheless, in spite of these difficulties, the author has produced an excellent book which will be of value to both the chemist and manufacturer. It should be stated that the latter is only catered for indirectly, and that the details of practical manufacture are too scanty to be of much use to him. What he can learn is the scientific principles underlying the various operations.

The book is divided into two parts, viz. (1) Theoretical Aspects, and (2) Technological Aspects. An appendix contains details of the measurement and expression of hydrogen-ion concentration, p_H values and various tables. In the first part, the chemistry of gelatin is dealt with fully, the work of all recent investigations of its colloidal properties being clearly described under the following heads:—(1) The constitution of the proteins; (2) the chemistry of gelatin and its congeners; (3) the physicochemical properties and structure of gelatin; (4) gelatin as a lyophilic colloid; (5) gelatin as an amphoteric colloid. Chemical equations and mathematical expressions are used freely. Good descriptions are given of the cleavage products of proteins and of the determination of amino-acids and the Hausmann numbers.

Among the details of manufacturing processes is a suggestive description of the application of the determination of the specific conductivity of a glue liquor as a means of controlling its clarification. But the author appears to have limited his experiments to determining the point at which the soluble salts are at a minimum. He states, quite rightly, that indicator colour changes are of little use in controlling glue liquors. Seventy-five pages are devoted to the testing of glue and gelatin. A large number of physical and chemical methods is described and a useful attempt is made to divide the

tests into "fundamental" and "secondary." As the result of work previously published by himself, the author concludes that the jelly strength of a glue depends upon the percentage of the total nitrogen present as unhydrolysed protein and that "amino" nitrogen is of little value as a factor for analytical purposes. This is in agreement with the conclusions published recently by the Adhesives Research Committee. Stress is laid on the importance of determining the p_H value of a one per cent. solution of the glue, though it is doubtful if the indications given by the test are so clear as the author thinks. The properties of a glue or gelatin are largely determined by the washing and boiling processes, and no subsequent adjustment of its p_H value could make good mistakes made in these operations.

The book concludes with a description of some of the uses and application of glue and, in dealing with glue as an adhesive, the factors affecting the strength of a glued joint are fully dealt with. The book is excellently printed and the bibliography full and generous.

S. R. TROTMAN.

- (1) THE GENERAL PRINCIPLES OF CHEMICAL ENGINEERING DESIGN, by H. GRIFFITHS. Pp. 63.
 - (2) THE WEIGHING AND MEASURING OF CHEMICAL SUBSTANCES, by H. L. MALAN and A. T. ROBINSON. Pp. 63.
 - (3) MATERIALS OF CHEMICAL PLANT CONSTRUCTION: NON-METALS, by H. GRIFFITHS. Pp. 64.
 - (4) THE FLOW OF LIQUIDS IN PIPES, by N. SWINDIN. Pp. 61.
 - (5) PUMPING IN THE CHEMICAL WORKS, by N. SWINDIN. Pp. 80.
- Chemical Engineering Library. London: Benn Brothers, Ltd. 1922. Price per volume 3s. net.*

Messrs. Benn Bros. have published a set of five booklets on various sections of chemical engineering, which, although quite useful compilations, hardly justify the claim made on the printed wrapper that they will form a complete and authoritative reference library.

(1) In this volume the need is pointed out of breeding chemical engineers, of whom so few yet exist. Much has been written on the subject, but events are now moving and the position of the chemical engineer at the moment is somewhat similar to that of the electrical engineer in the 'eighties. The monograph gives a brief but good outline of the subject indicated by its title, showing the necessity for the pure chemist to be well up in all branches of science as well as his own, and to have a good knowledge of physics. The writer urges the necessity for an intelligent use of formulae, many of which are necessarily empirical, and regards too much "common sense" as a sign of ignorance and rule-of-thumb. He emphasises the need for research in chemical engineering and the preliminary study of the ground before any plant is designed. A chapter is devoted to many details, small and large, which go to make up a plant, and the whole monograph is one that will be read with pleasure by any practical chemical engineer.

(2) The writer gives a general survey of the methods of intermittent measurements of liquids by filling tanks or eggs, with a polar diagram for the calibration of large cylindrical tanks, but entirely

omits the gauged-flow method for this operation, which is by far the quickest and most accurate. He describes the various types of water-meters in use, viz., reciprocating and turbine meters, and gives a good description of the Venturi-meter and weir-recorder. A short chapter is devoted to the outlines of automatic weighing machines and continuous volume-measurement of granular substances. The limits of space, no doubt, preclude the mention of many designs of apparatus of equal interest to that mentioned.

(3) This booklet devotes its first chapters to all general building materials and especially to their acid-resisting properties. There are some noticeable divergencies in the figures given for fire-bricks. On page 16 the writer states the porosity to be 7 per cent., and on page 19 gives a figure of 10—15 per cent. The crushing strength per square foot is given as 250 tons on page 16, and on page 19 as 110—128 tons. Specific gravity he quotes as 1.8 on page 25 and on page 16 as 2.16. Also, surely Volvic stone comes from the centre not the south of France? Stoneware and glass, artificial stones and "vitresoil" are mentioned with their good and bad points. The use and abuse of wood are discussed in very useful detail, and paints, cements and jointing materials described, but the acid-workers' old friend, "blackman," is not mentioned. This brochure is a useful one, and the few errors mentioned will, no doubt, be corrected in a subsequent edition.

(4) The author reviews the work of Reynolds, Poiseuille, D'Arcy, Stanton and Parry, gives a clear exposition of each, and makes a plea for a general standard of units in place of c. g. s; ft.-pd.-second; metre-kg.-second. He gives an account of the conditions governing the flow of liquids in pipes and channels with a wealth of diagrams and tables, including those for losses due to bends and cocks in pipes. He demonstrates the saving in power by the use of large pipes, which allow the rate of flow to be slow enough to keep within the stream-line limits; also the fact that the mean velocity is a definite function of the velocity at the centre of the pipe, so that only one reading with the pitou-tube is necessary. There are some gaps in the tables given yet to be filled up. He omits any use of the calculus and so provides a handbook that is quite suitable for popular consumption.

(5) In this volume are described most of the types of pumps and methods of pumping met with in chemical manufacture, special regard being had to the movement of corrosive liquids. The writer deals fairly with the different types, but the details are necessarily meagre owing to the small size of the book. His statements will not perhaps meet with universal agreement; for instance, he alleges that a theoretically-minded man would prefer mechanical pumps. This is quite contrary to the experience of the reviewer, who has frequently had to apply the brake to the ultra-theoretical man. In the section devoted to centrifugal pumps, the writer gives a list of makers' names with a digest of their statements, but it is rather noticeable that he omits the firm which has been longest in this field and whose experience must be as great as that of all the others put together. He mentions the difficulties in the making of pumps from iron alloys, due to the brittleness of this material, but omits the troubles due to variations in composition which have caused

chemists much tribulation in the past. Rotary pumps are described shortly and receive all the attention they deserve, but no mention is made of wear, which in most cases is a serious item. Pumping by means of air pressure and eggs is very fully gone into, and the use of steam- and air-ejectors explained. The author reserves his approval for the air-lift, pure and simple, which he describes, and of which he explains the theory in detail, although it may perhaps be permitted to doubt the efficiencies he mentions. This small book is a good one, and within its limitations covers the ground in excellent fashion.

F. A. GREENE.

PHYSICAL AND CHEMICAL EXAMINATION OF PAINTS, VARNISHES AND COLOURS. By HENRY A. GARDNER, *Director, Scientific Section, Education Bureau of the Paint Manufacturers' Association of the United States, and the National Varnish Manufacturers' Association Incorporation*. Pp. 218, and supplement of about 150 pages consisting of Circulars issued by the Interdepartmental Committee, Standard Specifications Board, U.S. Government. Washington: P. H. Butler, 1845, B Street, N.W., 1922. Price \$9.

The name of the author of this volume is familiar to everyone acquainted with the scientific and technical literature of the Paint and Varnish Industry, for as Director of the Scientific Section of the Educational Bureau above named, Mr. Gardner is probably the most prolific contributor to the literature of the industry. The present work consists of a collection of methods for the physical and chemical examination of paints, varnishes and colours, together with copies of a number of Standard Specifications issued by the United States Government. In these days, when the mass of technical literature is so great, it is often difficult for those engaged in industry to read, let alone thoroughly digest, all the new work dealing with their own industry, and, viewed from this standpoint, the volume under review has a certain value; subsequent editions can, however, be considerably improved by careful revision.

Chapters I to XIV show clearly the rapid development which is taking place in the application of physical methods of investigation in the paint and varnish industry, and these chapters prove the most attractive, for therein the author deals with the most up-to-date work on such problems as oil absorption, viscosity, surface tension and interfacial tension of varnishes and paint liquids, and colour standards.

The chapter dealing with the testing of paint films, the Pfund Cryptometer, the colorimeter, and paint film gauge, is of particular interest, the construction and use of the instruments being carefully described. No attention is given to the microscopic examination and measurement of pigment particles, and this is a serious omission, because it is generally agreed that by no other means can the fineness of a pigment be determined. The chapter on the texture of pigments is an interesting but too discursive treatment of a difficult subject, and its value is not sensibly increased by the photomicrographs reproduced. The treatment of a most important subject, viz., exposure tests, is meagre and by no means sufficient for a work of this type, and in a new

edition page 77 might be recast with advantage so as to secure uniformity of method of expression.

A number of chapters deal with the analysis of mixed driers, shellac, resins, bituminous paints, white paints, lead oxides, vermilion and other pigments, and it is only possible in a review of this description to draw attention to a few features which might with advantage be altered in a new edition. It is important to note that the composition of English basic sulphate of lead is not similar to that quoted by the author for the American product. In English brands, the zinc-oxide content is usually less than the 5.5 per cent. stated to be American standard.

Methods for the analysis of the new titanium pigments are given, but whilst mention is made of the use of antimony oxide as a pigment, the reader is referred to another publication for details of methods of analysis—an inconvenient feature in a work of this type.

Exception must be taken to the statement on page 183 that whilst the lead oxide pigments in the pure form are of the generally accepted formula Pb_3O_4 , they are "probably mixtures of lead monoxide and lead dioxide" and further, that "in chemical composition they are the same, the proportions of lead monoxide and dioxide varying, however, but by their physical structure and colour they can be readily differentiated." The first statement is incorrect and the second is so involved that its meaning is not clear.

The remaining pages of the book consists of actual copies of 18 Circulars issued by the United States Government. These are excellent productions, each being a complete work in itself. This feature, however, involves much repetition, particularly of methods of testing and preparation of reagents. Thus, the same methods for the preparation of standard solutions of sodium thiosulphate, starch solution, standard iodine solution, alcoholic sodium hydroxide, etc. are described at least a dozen times, and similarly, the same laboratory methods for the examination of dry pigments are described time over again. Such repetition is unavoidable when the circulars are printed for sale as separate complete works, but it makes tedious reading in a work such as that under review. Further, each specification can be purchased at 5 cents per copy, so that 150 out of the 380 pages contained in the volume are purchasable for 90 cents, leaving less than 250 actually written by the author. In view of this, the price of 9 dollars for the work is excessive and will certainly militate against the free sale of the book, even though, as is always the case with the author's productions, the volume is well bound, clearly printed and free of printer's errors.

C. A. KLEIN.

With reference to the review of *DIE LÖSUNGSMITTEL DER FETTE, ÖLE, WACHSE UND HARZE*, by Dr. H. Wolff, which appeared in our issue for October 16, the publishers, Die Wissenschaftliche Verlagsgesellschaft m.b.H., Stuttgart, write to say that the book is to be had bound as well as in brochure form; for reasons of economy the latter form is sent out for review. The price to purchasers in England has now been reduced to 5s., bound, whilst the price in Germany has been raised to 1600 marks.

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- AN IMPROVED METHOD FOR PREPARING RAFFINOSE. By E. P. CLARK. No. 432. Price 5 cents.
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- TESTS OF STELLAR RADIOMETERS AND MEASUREMENTS OF THE ENERGY DISTRIBUTION IN THE SPECTRA OF 16 STARS. By W. W. COBLENTZ. No. 438. Price 10 cents.
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- MEASUREMENT OF THE COLOUR TEMPERATURE OF THE MORE EFFICIENT ARTIFICIAL LIGHT SOURCES BY THE METHOD OF ROTATORY DISPERSION. By I. G. PRIEST. No. 443. Price 5 cents.
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